

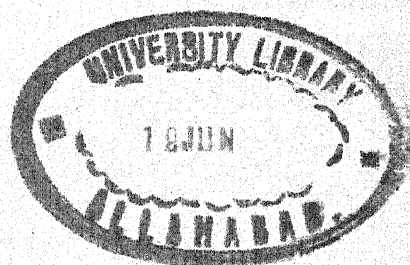
# MOSS FLORA

OF

## NORTH AMERICA

North of Mexico

### GRIMMIACEAE



BY

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## VOLUME II

Part I

PUBLISHED BY A. J. GROUT

NEWFANE, VERMONT

NOVEMBER, 1933.



## Family GRIMMIACEAE.\*

Chiefly rupestral dark green mosses of various habit; leaves numerous, very hygroscopic, polyseriate, often hyaline pointed; upper leaf cells small, usually roundish, more or less opaque, often bi- or tri-stratose, sometimes papillose; lower cells quadrate, rectangular or linear, the walls smooth, sinuose, or nodulose; archegonia, and later the capsules, acrocarpous or occasionally cladocarpous; antheridia gemmiform; seta straight or arcuate; capsule ovoid, ellipsoid, or cylindrical, immersed, emergent, or exserted; calyptra various; stomata often present, usually gymnoporous, sometimes obsolete; columella either free from the lid, or attached to the lid and deciduous with it; peristome single, rarely absent; basal membrane absent (or a short basal membrane present in *Campylostelium*); teeth 16, reddish, membranous, without vertical striae, entire, cribose, or 2-3-cleft to the base or nearly to the base, arising from a single series of cells of the amphithecium; exterior plates usually thicker than the inner ones and often transversely trabeculate; pre-peristome sometimes present.

Several families, as *Hedwigiaceae*, *Ptychomitriaceae*, chiefly distinguished by vegetative characters, have been segregated, but they are all closely allied through their sporophytic characters and are best considered as subfamilies of the Grimmiaceae. In the present treatment, eight genera belonging to four subfamilies are recognized for North America north of Mexico.

Few fossil specimens of the *Grimmiaceae* are known. Dixon (Fossilium Catalogus, vol. 2, part 13, Muscineae, Berlin, 1927) lists twenty-four specimens which have been found from 1853 to 1924 in the Quaternary and Tertiary. One species has been found in amber. All but one are from western Europe. The only species from North America that is listed by Dixon is *Glyphomitrium Cockerelleae* E. G. Britt. & Hollick, from the Tertiary shales of Colorado.† The existence of these specimens establishes the fact that mosses of a distinct grimmiaceous type existed as early as the Tertiary.

### SYNOPTICAL KEY TO SUBFAMILIES AND GENERA.

Peristome teeth cuneiform, entire, cribose, or 2-3-cleft above the middle, or peristome none.

Leaves costate.

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| <p>Archegonia, and later, the capsules, terminal (acrocarpous); stems usually short, erect, with regular, often dichotomously arranged branches of nearly equal length (except in some species or varieties of <i>Grimmia</i>); peristome usually present. ....</p> <p>Peristome teeth entire, united in pairs and reflexed when dry against the wall of the capsule; perichaetial leaves convolutedly clasping the seta; central cylinder of the stem none; autoicous species with muticous leaves. ....</p> <p>Peristome teeth usually cribose, or 2-3-cleft above the middle, seldom entire, not united in pairs and reflexed against the wall of the capsule; perichaetial leaves not convolutedly clasping the seta; central cylinder of the stem usually present; autoicous or dioicous species. ....</p> <p>Archegonia, and later, the capsules lateral (cladocarpous); stems elongated, irregularly branched; dioicous species. ....</p> | <p>Subfamily 1. <i>Grimmieae</i>.</p> <p>1. <i>Glyphomitrium</i>.</p> <p>2. <i>Grimmia</i>.</p> <p>Subfamily 2. <i>Scoulerieae</i>.</p> <p>3. <i>Scouleria</i>.</p> |
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\* Contribution No. 35 from the Department of Botany of the State College of Washington.

The investigations resulting in this revision were carried on at the Herbarium of the State College of Washington at Pullman, Washington. The writer is deeply indebted to Dr. F. L. Pickett, Head of the Department of Botany at that institution, for having made possible the completion of this work; also to Dr. T. C. Frye of the University of Washington at Seattle for having suggested the problem in 1926, and for frequent encouragement and advice since that time. To L. Loeske of Berlin I acknowledge with appreciation my indebtedness to his treatment of the European Grimmiaceae. Specimens have been studied from the herbaria of Mr. E. B. Bartram, Mr. Seville Flowers, Dr. A. J. Grout, Dr. F. L. Pickett, Professor C. L. Porter, Dr. T. C. Frye, Dr. Ruth D. Svihla, Dr. H. S. Conard, the Provincial Museum of Natural History at Victoria, British Columbia, the University of California, the State College of Washington, the University of Washington, the New York Botanical Garden, and the small collection of the writer. To these individuals and to the curators of the various herbaria, grateful acknowledgment is here made. Only a few of the specimens seen and studied are listed among the exsiccati.

† Bull. Torr. Club 34: 140, pl. 9. 1907.

## GRIMMIACEAE—GRIMMIEAE

- Leaves ecostate; stems elongated, irregularly branched; peristome none; autoicous species. . . . . Subfamily 3. Hedwigieae.  
 Capsule exserted; calyptra large, cucullate; leaf-cells with simple papillae. . . . . 4. *Braunia*.  
 Capsule immersed or emergent; calyptra small, subcucullate; leaf-cells with bifurcate papillae. . . . . 5. *Hedwigia*.  
 Peristome teeth subulate or linear, 2-3-cleft to the base or nearly to the base; leaves costate. . . . . Subfamily 4. Ptychomitriaceae.  
 Autoicous species; leaves crispate when dry; basal leaf-cells rectangular, smooth-walled; central cylinder of the stem present.  
 Seta arcuate; calyptra mitrate, non-plicate. . . . . 6. *Campylostelium*.  
 Seta straight; calyptra campanulate, lobate, plicate. . . . . 7. *Ptychomitrium*.  
 Dioicous species; leaves usually non-crispate when dry; basal leaf-cells linear, with nodulose or sinuose walls; central cylinder of the stem undifferentiated; seta straight; calyptra mitrate, non-plicate. . . . . 8. *Rhacomitrium*.

## AN ARTIFICIAL KEY TO THE GENERA BASED CHIEFLY ON GAMETOPHYTIC CHARACTERS.

- Leaves costate.  
 Leaves imbricated, not crisped when dry.  
 Basal cells smooth-walled.  
 At least the upper leaves piliferous. . . . . 2. *Grimmia*.  
 Leaves muticous.  
 Costa without rhizoids at base. . . . . 2. *Grimmia*, subgen. *Schistidium*, and subgen. *Eugrimmia*, § *Orthogrimmia*.  
 Costa with some rhizoids at base. . . . . 3. *Scouleria*.  
 Basal cells nodulose or sinuose.  
 Basal cells nodulose. . . . . 8. *Rhacomitrium*, subgen. *Eurhacomitrium*.  
 Basal cells sinuose.  
 Costa 2-ridged on back. . . . . 8. *Rhacomitrium*, subgen. *Dryptodon*.  
 Costa not ridged. . . . . 2. *Grimmia*, subgen. *Eugrimmia*, § *Orthogrimmia* and § *Rhabdogrimmia*.  
 Leaves crisped, curled or twisted when dry.  
 At least the upper leaves piliferous. . . . . 2. *Grimmia*, subgen. *Eugrimmia*, § *Rhabdogrimmia*.  
 Leaves muticous.  
 Perichaetial leaves convolutely clasping the seta. . . . . 1. *Glyphomitrium*.  
 Perichaetial leaves not clasping the seta.  
 Leaves entire.  
 Calyptra plicate. . . . . 7. *Ptychomitrium*.  
 Calyptra non-plicate.  
 Capsule cylindrical, exserted on a long seta; lid subulate, as long as the capsule. . . . . 6. *Campylostelium*.  
 Capsule ovoid or ellipsoid, immersed or emergent; lid rostrate. . . . . 2. *Grimmia* subgen. *Schistidium*, and subgen. *Eugrimmia*, § *Rhabdogrimmia*.  
 Leaves serrate in the upper half; calyptra plicate. . . . . 7. *Ptychomitrium*.  
 Leaves ecostate.  
 Leaf cells with simple papillae. . . . . 4. *Braunia*.  
 Leaf cells with bifurcate papillae. . . . . 5. *Hedwigia*.

## Subfamily 1. GRIMMIEAE Limpr. Laubm. 1: 702. 1888.

Stems usually short, with regular, often dichotomously arranged branches of nearly equal length (except in *Grimmia alpicola*, var. *rivularis*, and *G. apocarpa*, var. *gracilis*); perichaetial leaves convolutely clasping the seta in *Glyphomitrium*, but not in *Grimmia*; archegonia, and later the capsule, terminal (*acro-*

*carpous*); *peristome teeth cuneiform, entire, cribose, or 2-3-cleft above the middle*, united in pairs and reflexed when dry against the wall of the capsule (*Glyphomitrium*), erect or spreading or peristome none (*Grimmia*).

Since forms with cleft teeth were probably derived from those with entire or merely cribose teeth (within the same cycle of affinity), and the cladocarpous or pleurocarpous habit was probably preceded by the acrocarpous, it is assumed that the Grimmiaceae is the most primitive subfamily. It contains the greatest number of species and is most widely distributed throughout the world. It includes two genera, *Glyphomitrium* and *Grimmia*.

#### 1. GLYPHOMITRIUM Brid. Mant. Musc. 30. 1819.

Plants small, slender, in low, glossy, greenish or brownish green tufts; stems spreading, with numerous erect, simple branches; central strand none; leaves linear to lanceolate, curled or crisped when dry, erect-patent when moist, with entire, plane or more or less revolute margins; upper and median leaf cells small, thick-walled, roundish-quadrate, opaque, those at the base of the leaf near the costa rectangular; *perichaetial leaves convolutely clasping the seta*. Autoicous; antheridia axillary; seta erect; capsule terminal, exserted, symmetrical, ellipsoidal to globose, small, smooth, thin-walled; annulus undifferentiated; *peristome teeth entire, cuneiform, united in pairs and reflexed when dry against the wall of the capsule*, sometimes with hyaline margins; lid rostrate; calyptra large, completely covering the capsule, campanulate-mitrate, lobate at base, plicate, glabrous; spores large.

This genus is probably most closely related to *Grimmia*, from which it is distinguished by the entire peristome teeth being united in pairs and reflexed when dry against the wall of the capsule, and by the peculiar convolute perichaetial leaves. Brotherus\* lists five species, of which only the following one has been reported from North America.

#### GLYPHOMITRIUM CANADENSE Mitt. Journ. Proc. Linn. Soc. 8: 21. 1865.

Plants pulvinate in thick tufts; leaves linear-lanceolate, mucous, somewhat canaliculate in the upper part, unistratose except on the margins; costa percurrent; margins plane or somewhat recurved in the lower part of the leaf, bistratose in the upper part; leaf-cells thick-walled, the upper and median ones roundish-quadrate; basal cells rectangular, becoming shorter and broader toward the margins of the leaf; perichaetial leaves broadly ovate, shortly apiculate, convolute and clasping the base of the seta. Autoicous; antheridial buds axillary; antheridia short-stalked, exceeded by the paraphyses; seta 2-3 mm. long, pale green; capsule ellipsoidal, 1.5 mm. long (including the lid); calyptra† 1.5 mm. long, rugulose at apex, nearly equally lobate at base; lid 0.5 mm. long, rostrate; peristome unknown.

Type locality, "British North America." Collected by Drummond.

There appears to have been only one collection of *Glyphomitrium canadense*. This species is included in the genus *Glyphomitrium* on account of the peculiar convolutely clasping perichaetial leaves. The mature peristome is unknown. The large plicate calyptra resembles that of *Ptychomitrium* and *Grimmia*, subgen. *Coscinodon*. From *Glyphomitrium Daviesii* Brid. of Britain, Norway, and the Faeroes, it is apparently quite distinct in the longer, ellipsoidal capsule, the shorter lid, the thick-walled basal leaf cells, and the leaves being only slightly curled when dry.

ILLUSTRATIONS.—Pl. 1.

EXSICCATI.—British North America [Canada], without definite locality, *Drummond*. Type in Herb. Wm. Mitten at the New York Botanical Garden.‡

#### 2. GRIMMIA Ehrh. in Hedw. Fund. Musc. Frond. 2: 89. 1782 and Sp. Musc. 73. 1801.

Small, usually pulvinate or cespitose, rupestral mosses, often grayish on account of the hyaline points of the leaves; stems numerous, blackish green at the base, usually somewhat dichotomously branched, short tuft-like lateral branchlets usually lacking; stems usually bearing rhizoids only near the base; central cylinder usually present, consisting of small, thin-walled cells, surrounded by a larger-celled cortical tissue which in the older and outer parts of the stem often has its walls thickened and reddish brown; leaves crowded,

\* Engler & Prantl (Ed. 2) 11: 10. 1925.

† Although the calyptra belongs to the gametophyte, for convenience it is described with the capsule in this treatment of the *Grimmiaceae*.

‡ Thanks are due to Mr. R. S. Williams of the New York Botanical Garden, and to Dr. A. J. Grout, for the privilege of examining a part of the type specimen.

plane, convex, or carinate, very hygroscopic, crisped or spirally twisted in a few species, but usually imbricated when dry; when moistened they are recurved, gradually becoming erect-ascending; lower leaves usually small and muticous, scale-like and appressed, the upper ones much larger and as a rule more or less hyaline tipped with a smooth, or more or less spinulose hair-point, consisting of linear hyaline cells, this hyaline portion consisting of the lamina instead of the costa alone; costa complete, well-developed, mostly homogeneous, single, percurrent, subpercurrent or slightly excurrent, flat, or prominently convex on the dorsal\* side of the leaf; median and upper leaf cells 1-4-stratose, sometimes papillose, usually more or less incrassate, often sinuose, mostly small and roundish-quadrate; basal cells rectangular, quadrate, or linear, usually smooth-walled, occasionally somewhat sinuose, but never nodulose, often more or less hyaline; perichaetial leaves usually somewhat larger with longer hair points and the basal cells elongated and somewhat pellucid; archegonia and antheridia usually terminal in bud-like clusters; inflorescence autoicous or dioicous, never synoicous; paraphyses few; setae of variable length, but usually short, either straight or arcuate, twisted to the left; sheath naked, usually with a short ocrea; capsules erect or curved downward, symmetrical or ventricose, hemispherical, ovoid, ellipsoid or cylindrical, smooth or longitudinally ribbed or sulcate when dry, sometimes wide-mouthed and funnel-shaped when dry and empty; calyptra fugacious, smooth or plicate, campanulate-mitrate, mitrate and lobate at the base, or cucullate, mostly long-beaked, occasionally completely covering the capsule, usually reaching below the lid, or sometimes not extending as far as the base of the lid; lid always shorter than the capsule, sometimes falling with the calyptra, mamillate, conical, or either straight or obliquely beaked; stomata when present usually in one row at the base of the capsule, seldom obsolete; air cavities usually present, at least at the base of the spore sac; columella often twisted near the lid, either persistent, or falling with the lid; annulus usually present, of 1-4 rows of cells, persistent, or falling away in fragments, sometimes revolvable, often absent; peristome single, usually present, though sometimes rudimentary or absent, basal membrane none; teeth 16, reddish, cuneiform, flat, subentire, cribose, or 2-3-cleft to the middle, trabeculate; spores small, yellowish, 5-25  $\mu$  in diameter, smooth or granuliferous.

The genus *Grimmia* was first described by Friedrich Ehrhart in Hedwig's *Fundamentum Historiae Naturalis Muscorum Frondosorum* in 1782, and later, in 1787, in his *Beiträge zur Naturkunde*. It was named in honor of Johann Friedrich Karl Grimm, a physician and amateur botanist of Gotha, Germany who was born at Eisenach on February 5, 1737, and died at Gotha on October 28, 1821. Ehrhart founded the new genus on *Bryum apocarpum*,  $\alpha$ , and on *B. striatum*,  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , of Linnaeus.† These plants were collected by Dillenius on rocks in the neighborhood of Schiffenberg, near Giessen, Germany.‡ From 1782 until the present time several hundred species have been proposed. Brotherus in 1924, listed 227 species of *Grimmia* and 9 species of *Coscinodon* for the entire world.§ The present revision includes 72 species, varieties, and forms for North America north of Mexico.

The species of *Grimmia* that are known to occur in North America may be grouped into the three subgenera, *Schistidium*, *Coscinodon*, and *Eugrimmia*, each of which, at one time or another, has been treated as a separate genus. That treatment is preferred by some botanists at the present time, but since these groups were based on characters which are now assumed to be of less than generic value, it is considered better to treat them here as subgenera. Otherwise, the expression of relationship between these units is obscured or at least partially destroyed. First place is given to the subgenus *Schistidium* because of its apparent closer relationship, as indicated by the peristome, with some of the *Dicranaceae*.

#### SYNOPSIS OF THE GENUS GRIMMIA.

Subgenus 1. *Schistidium*. Columella usually attached to the lid and deciduous with it; calyptra scarcely longer than the lid, non-plicate; capsule immersed.

Subgenus 2. *Coscinodon*. Columella free from the lid and persistent; calyptra covering the capsule to the middle or below, plicate.

Subgenus 3. *Eugrimmia*. Columella free from the lid and persistent; calyptra scarcely longer than the lid, non-plicate.

\* *Dorsal*, relating to the back, or attached thereto; the surface turned away from the axis, (abaxial) which in a leaf is the lower surface.

† Sp. Pl. 2: 1115, 1753.

‡ Limpricht, K. G. Die Laubm. Deutschlands, etc. 1: 705, 1889.

§ Engler & Prantl (Ed. 2) 10: 305, 306, 1924.

- Section 1. Orthogrimmia. Seta straight, and nearly always longer than the capsule, or if arcuate, shorter than the ventricose capsule; capsule seldom sulcate when dry.
- Subsection 1. Hydrogrimmia. Median and upper leaf cells 12–15  $\mu$  in diameter; leaves ovate-lanceolate, obtuse, muticous, concave, unistratose, non-carinate.
- Subsection 2. Gasterogrimmia. Capsule more or less ventricose at base; seta arcuate, usually shorter than the capsule; species chiefly autoicous.
- Subsection 3. Litoneurum. Leaves not keeled, costa flattened, often somewhat obscure; margins usually plane or nearly so; capsule usually symmetrical; dioicous species.
- Subsection 4. Alpestres. Leaves keeled, costa prominently convex on the dorsal side of the leaf; margins usually revolute; basal cells smooth-walled; capsule symmetrical.
- Subsection 5. Alpinae. Leaves and costae as in Alpestres except that the basal cells are narrow and with more or less sinuose and incrassate walls.
- Section 2. Rhabdogrimmia. Seta arcuate or flexuose when moist, longer than the capsule which is sulcate or longitudinally ribbed to obscurely striate when dry.
- Subsection 1. Pulvinatae. Autoicous species, leaves ovate or oblong, acute or obtuse, abruptly piliferous, imbricated when dry.
- Subsection 2. Torquatae. Dioicous species; leaves lanceolate, acuminate, gradually piliferous, spirally twisted around the stem and sometimes crisped when dry; peristome poorly developed.
- Subsection 3. Trichophyllae. Dioicous or autoicous species; leaves as in Torquatae but not spirally twisted around the stem; peristome normal.

## ANALYTICAL KEY TO THE SPECIES.

- i. Columella usually attached to the lid and deciduous with it; capsule symmetrical, immersed, longer than the straight seta, often macrostomous when empty; stomata usually present, but few, small, and obsolete; calyptra small, scarcely longer than the lid, cucullate or mitrate, non-plicate; peristome teeth usually more or less perforated or cleft, but not decidedly cribose.....Subgenus
- i. Schistidium.
- A. Leaves muticous, not hyaline-hair-pointed, though sometimes with a hyaline end-cell or excurrent costa; capsule hemispherical or ovoid (except *G. Dupretii* and *G. apocarpa*, var. *atrofusca*).
- b. Leaves linear-lanceolate or ligulate, 0.5 mm. or less wide; margins plane, not thickened.
- Maritime plants; leaves somewhat curled when dry..... 1. *G. maritima*.
- Not maritime plants; leaves straight when dry..... 2. *G. Agassizii*.
- bb. Leaves ovate or lanceolate.
- c. Median and upper leaves 0.5 mm. or less in length, 0.2 mm. wide; margins plane; spores 6–9  $\mu$  in diameter..... 4. *G. atricha*.
- cc. Median and upper leaves 0.7–3 mm. long, more than 0.2 mm. wide; margins plane or revolute.
- d. Leaves ovate-lanceolate or lanceolate.
- Leaves entire; stems short.
- Leaves 0.7–1.3 mm. long; calyptra mitrate; spores 8–15  $\mu$  in diameter.
- Leaves bistratose, opaque and blackish in the upper half, unistratose and pellucid below; margins plane; peristome-teeth truncate at apex; spores 8–10  $\mu$  in diameter..... 6c. *G. apocarpa*, var. *atrofusca*.
- Leaves unistratose in upper half, not blackish; margins revolute; peristome teeth cuneiform, not truncate.
- Capsule ellipsoidal, only slightly longer than the seta; seta 0.6 mm. long; peristome teeth entire, smooth; spores 12–15  $\mu$  in diameter..... 3. *G. Dupretii*.

- Capsule ovoid-hemispherical, 2-4 times as long as the seta; seta 0.2-0.3 mm. long; peristome teeth cribose or cleft, strongly papillose; spores 8-10  $\mu$  in diameter..... 6g. Var. *conferta*, f. *obtusifolia*.
- Leaves 1.5-3 mm. long; calyptra cucullate, lobate at base; spores 16-20  $\mu$  in diameter; capsule 2-4 times as long as the seta..... 5. *G. alpicola*.
- Leaves more or less repand or dentate at apex; stems often more or less elongated; calyptra cucullate, lobate at base. 5a. Var. *rivularis*.
- dd. Leaves broadly ovate, 2 mm. long, 0.7-1 mm. wide, obtuse, concave; margins strongly revolute; calyptra cucullate; spores 15-20  $\mu$  in diameter..... 5b. Var. *latifolia*.
- AA. Leaves, at least those at the tips of the branches, with more or less developed hyaline points, sometimes not over 0.5 mm. long; lower leaves muticous; capsule ellipsoidal or cylindrical (except *G. apocarpa*, var. *conferta*).
- b. Leaves linear-lanceolate; margins revolute..... 6a. Var. *nigrescens*.
- bb. Leaves ovate-lanceolate or lanceolate.
- c. Leaf-margins conspicuously thickened, plane; costa terete..... 25. *G. teretivervis*.
- cc. Leaf-margins not conspicuously thickened, plane or revolute; costa semiterete, convex on the dorsal side of the leaf.
- d. Hyaline points of upper leaves short, usually 0.5 mm. or more in length, not over  $\frac{3}{4}$  the length of the leaf; calyptra mitrate.
- e. Plants pulvinate in small tufts 2-3 cm. high; costa usually not papillose on dorsal surface near apex; spores 7-12  $\mu$  in diameter.
- Median and upper leaves 1.5-2 mm. long; upper leaf-cells 7-10  $\mu$  in diameter; peristome-teeth dark red, nearly entire; capsule ellipsoidal.
- Basal cells near the costa quadrate or nearly so; peristome-teeth cuneiform..... 6. *G. apocarpa*.
- Basal cells rectangular; peristome reduced..... 6e. Var. *pulvinata*.
- Median and upper leaves mostly 0.7-1 mm. long (perichaetial leaves larger); upper leaf-cells 5-7  $\mu$  in diameter; peristome-teeth cribose or cleft; capsule ovoid-globose.
- Leaf-margins plane, or incurved on one side.
- Leaves prominently keeled, bistratose, opaque and blackish in the upper half, unistratose and pellucid below; peristome-teeth truncate at apex. 6c. Var. *atrofusca*.
- Leaves not keeled, not opaque or blackish in the upper half; peristome-teeth lanceolate..... 6d. Var. *brunnescens*.
- Leaf-margins more or less revolute or incurved on both margins; leaves prominently keeled.
- Leaves widest about the middle; stems numerous, crowded, filiform..... 6b. Var. *tenerrima*.
- Leaves widest below the middle; stems fewer, not filiform..... 6g. Var. *conferta*.
- ee. Plants slender in loose, spreading mats, 4-10 cm. long; leaves more or less secund, sometimes denticulate at apex; costa often somewhat papillose on the dorsal surface below the apex; spores 10-15  $\mu$  in diameter..... 6f. Var. *gracilis*.

- dd. Hyaline points of upper leaves long, usually  $\frac{1}{2}$  or more the length of the leaf; leaves variable in size or shape, lanceolate or ovate-lanceolate, with plane margins; perichaetial leaves strongly differentiated, much larger; calyptra cucullate; spores 6-11  $\mu$  in diameter.
- Leaves oblong-lanceolate or ovate, not sheathing at base, flat, not opaque in the upper part; costa semi-terete, prominent, more or less canaliculate; capsule ellipsoid-cylindrical; spores 6-8  $\mu$  in diameter; plants pulvinate. . . . . 6h. Var. *ambigua*.
- Leaves lanceolate to ovate, sheathing at the base, concave, opaque in the upper part; costa flat, not prominent; capsule short, semi-ovoid; spores 9-11  $\mu$  in diameter; plants loosely tufted, stems spreading, more or less elongated. 7. *G. heterophylla*.
2. Columella free from the lid and persistent.
- A. Calyptra large, covering the capsule to the middle or below, campanulate-mitrate, plicate; capsule symmetrical; seta straight; stomata usually present, often large; peristome teeth decidedly cribose; upper leaves with well-developed hyaline points; basal cells not sinuose. . . . . Subgenus 2. *Coscinodon*.
- Leaves ovate or obovate, or spatulate, non-plicate; seta shorter than the capsule; autoicous.
- Leaves sinuate-denticulate below apex. . . . . 8. *G. Wrightii*.
- Leaves entire. . . . . 9. *G. Rauli*.
- Leaves lanceolate or oblong; seta longer than the capsule; dioicous.
- Leaves plicate; capsule immersed, ovoid. . . . . 10. *G. cribrosa*.
- Leaves non-plicate; capsule exserted, ellipsoid. . . . . 11. *G. calyptrata*.
- AA. Calyptra small, scarcely longer than the lid, cucullate or mitrate, non-plicate; peristome teeth more or less perforated or cleft, but not decidedly cribose, or peristome sometimes lacking. . . Subgenus 3. *Eugrimmia*.
- B. Seta straight or nearly so, and nearly always longer than the capsule, (except *G. pilifera* and *G. arizonae*) or if arcuate, shorter than the ventricose capsule; capsule not longitudinally sulcate when dry (*Orthogrimmia*).
- b. Median and upper leaf-cells 12-15  $\mu$  in diameter; leaves ovate-lanceolate, obtuse, muticous, concave, unistratose, non-carinate. . . . . 12. *G. mollis*.
- bb. Median and upper leaf-cells 4-10  $\mu$  in diameter; leaves not as above in every particular.
- c. Capsules more or less asymmetrical, more or less distinctly ventricose at base (gasterocarpous); seta usually arcuate, mostly shorter than the capsule; leaf margins plane; basal cells not sinuose.
- Peristome none; leaves oblong-lanceolate; capsule immersed; calyptra mitrate; autoicous. . . . . 13. *G. anodon*.
- Peristome present, at least in a rudimentary condition.
- Autoicous species.
- Capsule immersed; calyptra mitrate.
- Leaves broadly ovate, bistratose, the decurrent hyaline hair points nearly as long as the laminae. . . . . 14. *G. americana*.
- Leaves ovate-lanceolate, unistratose, with short, non-decurrent arista. . . . . 15. *G. plagiopodia*.
- Capsule exserted; calyptra cucullate; leaves unistratose, oblong-lanceolate, all but the perichaetial leaves muticous. . . . . 16. *G. Moxleyi*.

- Dioicous species with the leaves bistratose in the upper half;  
calyptra mitrate. . . . . 17. *G. poecilostoma*.
- cc. Capsules symmetrical; setae straight.
- d. Basal leaf-cells smooth- and thin-walled, not sinuose or incrassate.
- e. Leaves not keeled; costa flattened, often somewhat obscure, especially in the upper part of the leaf, and not prominently convex on the dorsal side.
- At least the upper leaves hyaline hair pointed or hyaline-apiculate.
- Basal leaf cells roundish-quadrate; calyptra mitrate or sporophyte unknown.
- Leaves lanceolate, acuminate, nearly uniform in size; hyaline points narrow, not decurrent. . . . . 18. *G. glauca*.
- Leaves ovate, obtuse or acute, the lower ones much smaller; hyaline points broad at base and decurrent. . . . . 19. *G. laevigata*.
- Basal leaf cells rectangular or linear; calyptra cucullate.
- Peristome present. . . . . 20. *G. commutata*.
- Peristome none. . . . . 21. *G. olympica*.
- Leaves muticous.
- Calyptra cucullate; annulus none; stomata none; spores 7-8  $\mu$  in diameter. . . . . 22. *G. brevirostris*.
- Calyptra usually mitrate; annulus and stomata present; spores 10-15  $\mu$  in diameter. . . . . 23. *G. unicolor*.
- ee. Leaves strongly keeled; costa terete or semiterete, prominently convex on the dorsal side of the leaf.
- f. Basal leaf cells rectangular to elongate-rectangular or linear; autoicous species with piliferous leaves. . . . . 24. *G. Doniana*.
- ff. Basal leaf-cells roundish, quadrate, or shortly rectangular.
- Basal leaf-cells roundish, the cross walls not thicker than the long walls.
- Leaves linear-lanceolate, bistratose; margins conspicuously thickened; stems 1-2 cm. long. . . . . 25. *G. teretinnervis*.
- Leaves lanceolate or ovate-lanceolate, unistratose, including the margins; stems slender, 2-7 cm. long. . . . . 26. *G. tenuicaulis*.
- Basal leaf-cells quadrate or shortly rectangular, the cross walls often apparently somewhat thicker than the long walls.
- Leaves piliferous; calyptra cucullate; peristome teeth irregularly cleft to the middle and cribose.
- Lid obliquely beaked; capsule ovoid-ellipsoidal; leaves narrowly lanceolate; dioicous. . . . . 28. *G. montana*.
- Lid with a short straight beak; capsule cylindrical; leaves shortly lanceolate or ovate.
- Leaves non-plicate, or plications indistinct; dioicous. . . . . 29. *G. alpestris*.
- Leaves distinctly longitudinally plicate; autoicous 29a. Var. *microstoma*.
- Leaves muticous or shortly hyaline-apiculate (perichaetial leaves sometimes piliferous).
- Leaves distinctly longitudinally plicate; peristome teeth usually entire. . . . . 29b. Var. *caespiticia*.
- Leaves non-plicate; peristome teeth more or less cleft and cribose.

- Costa percurrent; dioicous.  
 Basal leaf-cells thin walled, hyaline. . . . . 29c. Var. *Manniae*.  
 Basal leaf-cells thick walled, yellowish green. . . 29d. Var. *Holzingeri*.  
 Costa subpercurrent; autoicous; basal leaf-cells  
 thick-walled, yellowish green. . . . . 27. *G. coloradensis*.
- dd. Basal leaf-cells more or less sinuose or incrassate, the cross walls  
 not noticeably thicker, the juxtacostal cells rectangular or  
 sometimes linear.
- e. Hyaline points of the leaves very long, 2-10 times the length  
 of the lamina which is about 1 mm. long. . . . . 30. *G. Brittoniae*.
- ee. Hyaline points shorter, not over one-third the length of the  
 lamina.
- f. Hyaline points short, about one-tenth the length of the  
 lamina on the upper leaves; leaves 1-1.8 mm. long;  
 costa distinctly narrowed at base; peristome teeth en-  
 tire or slightly cribose; capsule exserted; dioicous  
 species. . . . . 31. *G. elongata*.
- ff. Hyaline points longer (or leaves muticous in *G. ovalis*, f.  
*mutica*), about one-fourth the length of the lamina on  
 the upper leaves; leaves 2-3 mm. long; costa not nar-  
 rowed at base; peristome teeth 2-3-cleft.
- g. Capsule immersed; dioicous species; hyaline points  
 strongly spinulose.  
 Leaves more or less canaliculate; margins thickened in  
 the upper part of the leaf; cells at extreme base of  
 leaf elongate-rectangular, smooth and thin-walled,  
 the cells above these shortly rectangular or  
 quadrate, incrassate and sinuose. . . . . 32. *G. pilifera*.  
 Leaves plane; margins not thicker than the rest of the  
 leaf; basal juxtacostal cells linear or rectangular,  
 sinuose, incrassate, becoming shorter and broader  
 toward the leaf-margins. . . . . 33. *G. arizonae*.
- gg. Capsule exserted or emergent; hyaline points faintly  
 denticulate or almost smooth (or lacking in 34c).  
 Autoicous species; calyptra usually mitrate; leaves  
 with one margin slightly recurved, the other plane.  
 Leaves piliferous.  
 Capsule ovoid, not over 1.5 mm. long.  
 Capsule exserted; hyaline points about  $\frac{1}{3}$  the  
 length of the lamina. . . . . 34. *G. ovalis*.  
 Capsule emergent; hyaline points more than  $\frac{1}{3}$   
 the length of the lamina. . . . . 34a. f. *affinis*.  
 Capsule cylindrical, exserted, 2 mm. long; hyaline  
 points about  $\frac{1}{3}$  the length of the lamina. . . 34b. f. *cylindrica*.  
 Leaves muticous. . . . . 34c. f. *mutica*.
- Dioicous species; calyptra usually cucullate; leaf-  
 margins plane, erect or slightly incurved; leaves  
 piliferous. . . . . 20. *G. commutata*.
- BB. Seta arcuate or flexuose, at least when moist, longer than the sym-  
 metrical capsule which is often longitudinally sulcate when  
 dry (*Rhabdogrimmia*).
- b. Basal leaf-cells mostly thin- and smooth-walled, not or scarcely  
 sinuose or incrassate; leaf-margins plane, or sometimes re-  
 curved below the middle of the leaf.

- c. Leaves elliptical or oblong-lanceolate, obtuse or acute, plane, abruptly piliferous, imbricated when dry, 1-1.5 mm. long; leaf-cells distinct; autoicous species.
  - Leaf-margins bistratose; calyptra mitrate; lid beaked. . . . . 35. *G. pulvinata*.
  - Leaf-margins unistratose; calyptra cucullate; lid obtuse. . . . . 36. *G. orbicularis*.
- cc. Leaves linear or subulate to lanceolate, acuminate, gradually piliferous, or muticous; median and upper leaf-cells often more or less obscure, and opaque; dioicous species.
  - Leaves 1.5-2 mm. long, subulate, curved when moist, strongly twisted when dry; hair point short, nearly smooth; margins plane or recurved; costa distinct. . . . . 40. *G. incurva*.
  - Leaves 2-3.5 mm. long.
    - Leaf margins plane.
      - Leaves linear-subulate, canaliculate, muticous, homomalous-falcate when dry, hooked when moist. . . . . 39. *G. hamulosa*.
      - Leaves linear-lanceolate from an ovate base, canaliculate-concave, spinulose-piliferous, not falcate or hooked. . . . . 42. *G. Olneyi*.
    - Leaf margin recurved on one side; leaves linear-lanceolate, curved or twisted when dry; hair point faintly denticulate, or smooth. . . . . 41. *G. trichophylla*.
- bb. Basal leaf-cells incrassate and sinuose; costa prominent.
  - c. Leaves 0.75-1.5 mm. long; margins plane or slightly recurved.
    - Leaves linear-lanceolate, incurved, twisted and spirally contorted when dry; plants in large, loose, soft, yellowish green tufts. . . . . 37. *G. torquata*.
    - Leaves ovate-lanceolate, appressed and spirally inrolled on the stem when dry; plants in dense, smooth, gray or blackish tufts. . . . . 38. *G. funalis*.
  - cc. Leaves 1.5-3.5 mm. long, one or both margins recurved, at least in the lower half of the leaf.
    - d. Leaves muticous, lanceolate, non-papillose. . . . . 45. *G. densa*.
  - dd. Leaves piliferous.
    - e. Leaves lanceolate.
      - Leaves slightly contorted when dry, somewhat falcate, the upper ones usually with some globular gemmae on the tips; seta 3-4 mm. long; capsule smooth, 1.5-2 mm. long; lid short beaked.
        - Leaf cells not papillose, the basal ones rectangular. . . . 46. *G. Hartmani*.
        - Leaf cells papillose, the basal ones quadrate. . . . . 46a. Var. *anomala*.
      - Leaves imbricated when dry, non-gemmiferous; capsule 4-8-striate and sulcate when dry; lid long subulate-beaked.
        - Dioicous; annulus simple, persistent. . . . . 43. *G. Leibergii*.
        - Autoicous; annulus compound, deciduous. . . . . 44. *G. decipiens*.
  - ee. Leaves linear-lanceolate; gemmae absent, or if present, at leaf base or on dorsal side of leaf.
    - Leaves more or less papillose on the upper part, appressed when dry; basal cells linear, strongly sinuose and incrassate; stems 3-7 cm. long. . . . . 47. *G. elatior*.
    - Leaves non-papillose, often slightly twisted when dry; stems 1-3 cm. long.
      - Basal leaf cells narrowly rectangular, sinuose, somewhat hyaline; hair points smooth or faintly den-

- ticulate; plants in loose yellowish-green tufts  
 1.5-3 cm. high.  
 Leaves scarcely recurved when moist; capsule  
 ellipsoid..... 41. *G. trichophylla*.  
 Leaves arcuately recurved when moist; capsule  
 ovoid..... 41b. Var. *meridionalis*.  
 Basal leaf cells quadrate or shortly rectangular, sinu-  
 ose, scarcely hyaline; hair points often strongly  
 spinulose; plants in dark green or blackish green  
 tufts 1-2 cm. high..... 41a. Var. *Muehlenbeckii*.

Subgenus 1. SCHISTIDIUM Schimp. Coroll. 45. 1856.

Capsule symmetrical, immersed, nearly always longer than the straight seta, often macrostomous when empty; columella usually attached to the lid and deciduous with it; stomata usually present but few, small, or obsolete; calyptra small, scarcely longer than the lid, non-plicate, cucullate or mitrate; peristome teeth usually more or less perforated or cleft, but not decidedly cribose; autoicous.

1. GRIMMIA MARITIMA Turn. Musc. Hib. 23. 1804.

*Grimmia alpicola* & *maritima* Wahlenb. Fl. Lappon. 320. 1812.

*Grimmia rigida* Brid. Bryol. Univ. 1: 768. 1826.

*Schistidium maritimum* Bry. Eur. 3: (fasc. 25-28) 10. 1845.

*Grimmia crassinervia* C. Muell. Bot. Centralbl. No. 51. 1890.

*Grimmia Kindbergii* Holz. Bryologist 14: 32. 1911.

Plants in thick, robust rigid tufts, yellowish green above, dark green or blackish below; stems 1.5-3 cm. high, with reddish rhizoids at base, erect, leafy, angular in cross section, with a small central strand; leaves muticous, crowded, erect-spreading when moist, somewhat curved and stiff when dry, linear-lanceolate, 2-3 mm. long, 2-3-stratose in the upper half, entire, or slightly crenulate at the apex; margins plane, or slightly revolute at the base; costa broad at base, often papillose above, subpercurrent, percurrent, or excurrent; upper leaf cells small and incrassate, roundish-quadrate, 6-9  $\mu$  in diameter, papillose; basal cells shortly rectangular, or those at the margins quadrate; perichaetial leaves larger, with the costa excurrent. Autoicous; seta 0.5-1 mm. long, straight or somewhat curved in age; capsules usually numerous, immersed, ovoid, pale brown, thin-walled, wide-mouthed when empty; lid beaked; calyptra about 0.5 mm. long, conical, cucullate, very evanescent, often somewhat lacerate at base; annulus not differentiated; peristome teeth reddish, subentire or slightly cribose, papillose; spores large, granular, 20-24  $\mu$  in diameter, in winter.

Type locality, Balbriggan, Ireland.

ILLUSTRATIONS.—Bry. Eur. *pl.* 235; Braithw. Brit. Moss Fl. 2: *pl.* 46 D; Dixon, Stud. Handb. Brit. Mosses, (Ed. 3) *pl.* 17 J; Grout, Mosses with Hand-lens and Micr. *fig.* 55; Loeske, Laubm. Eur. *fig.* 3, *p.* 23, *fig.* 9f, *p.* 45; Moenk. Laubm. Eur. *fig.* 76b; *p.* 346; Roth, Eur. Laubm. 1, *pl.* 31.

EXSICCATI.—Macoun, Can. Musci. 244, 88; Holz. Musci Acro. Bor.-Am. 236; Collins 4701; Farlow 560; Fernald, Bartram & Long 711; Foster 946; Seiche 33; Gardner 137, 68, 76.

Alaska to California, along the coast, where it is quite common in many places; Labrador, Miquelon Island, New Brunswick and Nova Scotia to Massachusetts. On siliceous or basaltic rocks by the sea; seldom on calcareous rocks. It is the only true maritime species, often growing within reach of the spray. There seems to be a rather wide gap between this species and its nearest relative, although it is perhaps approached by *G. Agassizii*. There has been some confusion about the form of the calyptra. According to illustrations in the Bryologia Europaea and in Braithwaite's British Moss Flora it appears to be mitrate. On all the North American specimens examined, the calyptra is conical-cucullate and often somewhat lacerate at the base. The spores are larger than those of any other North American species of *Grimmia*, except *G. Agassizii*.

2. GRIMMIA AGASSIZII (Sull. & Lesq.) Lesq. & James, Man. N. Am. Mosses 136. 1884.

*Schistidium Agassizii* Sull. & Lesq. in Sull. Musc. & Hepat. U. S. 104. 1856.

*Grimmia apocarpa*, f. *linearis* Chal. Grim. Tatrens. 25. 1882.

*Schistidium angustum* Hagen, Musc. Norv. Bor. 57. 1889.

*Schistidium lineare* Limpr. Laubm. 3: 710. 1902.

*Grimmia angusta* Paris, Index. Bryol. (Ed. 2) 2: 262. 1904.

*Grimmia alpicola*, var. *angusta* Moenk. Laubm. 350. 1927.

Plants in thick blackish or olive green tufts; stems erect, few branched, 1–3 cm. long; central strand absent, or present in the fertile branches; leaves loosely imbricated, somewhat glossy, very dark green when dry, linear-lanceolate from a slightly broader base, or narrowly ligulate, obtuse or acute, 1.5–3 mm. long, *muticus*, or sometimes with a single hyaline end-cell, mostly unistratose or bistratose; *margins plane*, or revolute near base, entire, or somewhat erose near apex; costa thick, terete, subpercurrent; upper leaf cells sinuate or nearly smooth, roundish-quadrate, 10–12  $\mu$  in diameter; basal cells rectangular, more or less hyaline, smooth-walled, becoming quadrate towards the middle of the leaf; perichaetial leaves larger, lingulate. Autoicous; seta 0.8–1 mm. long; capsule immersed, short-ovoid or funnel-form, 1 mm. long, smooth, thin-walled, 1 mm. in diameter across the mouth when dry and empty; stomata none; calyptra cucullate; lid obliquely beaked, deciduous with the columella, the beak as long as the basal diameter of the lid; peristome teeth red, 0.5 mm. long, thick and entire below, cribose above, papillose; spores smooth, yellowish, variable in size, 15–25  $\mu$  in diameter.

Type locality, shore of Lake Superior, Ontario, Canada. Collected by Louis Agassiz in 1848.

On dry rocks, Quebec and Ontario; British Columbia; Utah. Europe.

ILLUSTRATIONS.—Roth, Eur. Laubm. 1: pl. 50; Loeske, Laubm. Eur. 1913, fig. 9c; Pl. 1.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 616; Collins 4484; Flowers 2044, 2079; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 137 (type collection), (Ed. 2) 203.

### 3. GRIMMIA DUPRETI Thér. Bryologist 10: 63. 1907.

Plants dark green, densely tufted; stems short, simple, erect 3–5 mm. long; *leaves muticus*, imbricated when dry, erect-spreading when moist, 1–1.3 mm. long, ovate or lanceolate, short-acuminate, carinate, obtuse, *unistratose in the upper half*; *margins entire, revolute*; costa narrow at base, wider above, percurrent; basal cells rectangular, those near the leaf-margins more or less hyaline; upper leaf-cells small, roundish-quadrate, chlorophyllose, incrassate, 6–8  $\mu$  in diameter; perichaetial leaves larger, sometimes with a short, hyaline apiculus, hyaline at base, margins revolute in the upper half of the leaf. Autoicous; seta 0.6 mm. long; capsule immersed, erect, 0.8 mm. long, ellipsoid, rounded at base, wide mouthed when empty, plicate when dry; calyptra mitrate, 0.75 mm. long; lid obliquely beaked; peristome-teeth red, smooth, entire; spores smooth, 12–15  $\mu$  in diameter, in summer.

Type locality, Oka, near Montreal, Canada. Collected by H. Dupret, August 2, 1905.

British Columbia, Wyoming, Utah, Colorado, Minnesota, Ontario, Quebec, Massachusetts, Vermont.

ILLUSTRATIONS.—Bryologist, 1. c. 63, pl. 8; Pl. 10.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 285; Macoun, Can. Musci 237; Porter 482; Flowers 1079; Garrett 183.

### 4. GRIMMIA ATRICHA C. Muell. & Kindb. Mac. Cat. Can. Pl. 6: 65. 1892.

Plants in small, dense, spreading tufts, 8–12 mm. high, bright green; stems erect, slender, mostly simple, leafy except at base; *leaves 0.5–0.7 mm. long*, appressed when dry, erect-spreading when moist, oblong-lanceolate or lingulate, obtuse, *muticus*; *margins plane*, unistratose; costa strong, broad, homogeneous, subpercurrent; leaf-cells not incrassate, faintly sinuose, the upper ones roundish, 3–6  $\mu$  in diameter, those at the base of the leaf larger, quadrate or rectangular, pellucid; perichaetial leaves much larger, broader, and thinner. Autoicous; seta erect, 0.5–1 mm. long; capsule immersed, ovoid-globose, wide mouthed when empty, less than 1 mm. long; columella attached to the lid and falling with it; lid straight-beaked; peristome-teeth entire, not papillose, yellowish or hyaline above, orange below; spores yellowish, smooth or nearly so, 6–9  $\mu$  in diameter.

Type locality, on the sloping face of broken rocks, Sproat Mountain, altitude 4,000 feet, Columbia River, British Columbia. Collected by John Macoun, June 24, 1890.

ILLUSTRATION.—Pl. 17.

EXSICCATI.—Macoun, Can. Musci 609.

As yet, this species is comparatively little known, but it is probably more widely distributed than the few collections indicate. Relatively few parts of North America have been subject to careful bryological exploration, and on that account many additional records of the occurrence of this interesting species may reasonably be expected.

## 5. GRIMMIA ALPICOLA Hedw. Sp. Musc. 77. 1801.

- Grimmia helvetica* Schkuhr, Deutschl. Moos. 48. 1810.  
*Grimmia apocarpa*, var. *alpicola* Hook. & Tayl. Musc. Brit. 87. 1818.  
*Grimmia crassa* Schleich. Cat. ed. 4, 40. 1821.  
*Grimmia apocarpa*  $\gamma$  *alpicola* Hartm. Handb. Skand. Fl. ed. 2, 306. 1832.  
*Schistidium apocarpum*, subvar.  $\gamma$   $\beta$  *alpicola* Bryol. Eur. 3: (fasc. 25-28) 8, 1845.  
*Grimmia apocarpa*, f. *alpicola* Zett. Rev. Grimm. 54. 1861.  
*Grimmia apocarpa*  $\beta$  *helvetica* Boulay, Fl. Crypt. 666. 1872.  
*Schistidium alpicola* Limpr. Laubm. 1: 707. 1889.  
*Grimmia cinclidodontea* C. Muell. Bot. Centralbl. 44: 388. 1890.  
*Schistidium alpicola*, var. *eualpicola* Loeske, Laubm. 1: 39. 1913.  
*Grimmia alpicola*, var. *eualpicola* Moenk. Laubm. 349. 1927.

Plants more or less pulvinate, dark or dull green; stems numerous, erect or nearly so, dichotomously branched, leafy, 1-5 cm. high; central strand present, well developed; leaves loosely imbricated when dry, erect-spreading when moist, ovate-lanceolate or lanceolate, tapering to an obtuse or acute apex, muticous, 2-3 mm. long; margins plane, or revolute and thickened from the middle of the leaf, entire, or sometimes somewhat denticulate near apex; costa stout, subpercurrent, often more or less canaliculate on the upper surface; leaf cells smooth or somewhat sinuate, more or less roundish or hexagonal in the upper part of the leaf, basal cells rectangular, or a row near the leaf-margins quadrate; perichaetial leaves larger, ovate-lanceolate or the inner ones linear-lanceolate. Autoicous; seta straight, usually shorter than the capsule; capsule immersed or emergent, obovate, ovoid, or shortly ellipsoid, about 0.5 mm. long, wide mouthed and yellowish green when empty, the wall-cells in several layers; calyptra 0.7-1 mm. long, usually cucullate; lid lighter colored than the capsule, convex, or with a short oblique beak 0.2 mm. long; annulus none; stomata few or obsolete; peristome-teeth large, spreading or reflexed when dry, cuneiform, papillose, cleft and cribose, strongly articulated; spores yellowish green, 16-20  $\mu$  in diameter, finely granular, winter to spring.

Type locality, Sweden. Collected by Olof Swartz.

ILLUSTRATIONS.—Bryol. Eur. pl. 234  $\gamma$   $\beta$ , 1-5; Hedw. Sp. Musc. pl. 15. Pl. 2.

EXSICCATI.—Bartram 1194, 155, 906, 342, 17; Flowers 837, 838, 839, 677, 2082; Macoun, Can. Musci 237; Pickett 131, 171, 174; Collins 3896a, 4568a, 5198, 4649.

On various rocks from sea-level in British Columbia to 10,000 ft. altitude in Utah. It ranges in North America from Greenland to Alaska, southward to Texas, Arizona, and New Mexico. *G. alpicola* has been treated as a variety of *G. apocarpa*, and it is often confused with that species, from which it can be readily distinguished by the cucullate calyptra, the much larger spores, and the muticous leaves. It is apparently more common than the var. *rivularis* (Brid.) Broth., which occurs usually in wetter habitats, and which may be usually distinguished by the longer stems and the leaves being more or less repand or dentate at the apex. However, specimens are occasionally found that show a combination of the pulvinate habit of *G. alpicola* and the dentate leaves of the var. *rivularis* on the same plant. It is possible that the characters relied upon to distinguish the var. *rivularis* are merely the result of environmental conditions, but no proof of that is available at the present time. Typical *G. alpicola* Hedw. has entire leaves and short stems.

## 5a. Var. RIVULARIS (Brid.) Broth. Laubm. Fennosk. 181. 1923.

- Grimmia rivularis* Brid., in Schrad. Bot. Journ. 1: 276. 1801.  
*Grimmia apocarpa*, var. *rivularis* Web. & Mohr. Taschenb. 129. 1807.  
*Grimmia alpicola*, var.  $\beta$  *rivularis* Wahlenb. Fl. Lapp. 320. 1812.  
*Grimmia apocarpa atrata* De Not. Syllab. No. 309. 1838.  
*Schistidium apocarpum* var.  $\gamma$  *rivulare* Bryol. Eur. 3: (fasc. 25-28) 8. 1845.  
*Schistidium apocarpum*  $\gamma$  *atrum* De Not. Epil. Briol. Ital. 711. 1869.  
*Schistidium alpicola*, var.  $\beta$  *rivulare* Limpr. Laubm. 1: 708. 1889.

Plants often floating; stems more or less elongated, 4-10 cm. long, branched, leafy; leaves ovate-lanceolate, muticous, about 2 mm. long, more or less repand or dentate at apex; costa prominent; capsule hemispherical or campanulate when empty; peristome large, teeth lanceolate or subulate-lanceolate, 0.5-0.7 mm. long, deep red, entire, cleft, or perforated; spores 16-20  $\mu$  in diameter, granular.

Type locality, European.

On rocks in or by streams, Greenland to Newfoundland, Quebec and Pennsylvania; Michigan; Alaska, Yukon and British Columbia to Oregon, Montana, Wyoming and Utah. Europe. Asia.

ILLUSTRATIONS.—Bry. Eur. *pl.* 2347; Roth, Eur. Laubm. 1, *pl.* 29 L; Loeske, Laubm. Eur. 1913, *figs.* 7, 8 *a-e, 9b*.

EXSICCATI.—Grout, N. Am. Musci Perf. 140; Holz. Musci Acro. Bor.-Am. 564, 61; Macoun, Can. Musci 239, 92, 85; Allen, Mosses Casc. Mts. 129; Bartram, 371a, 369, 152, 25, 331, 406, 435, 399; Collins, 3890, 4234; Henderson 12066, 12219, 12092.

*Forma papillosa* n. f.

Plants loosely tufted, bright green; stems slender, 0.5–1 cm. long; *leaves* without hair points but often with a hyaline end-cell, *lanceolate, acuminate*, 1–1.5 or 2 cm. long; *costa strongly papillose on back*; margins more or less recurved, strongly denticulate or papillose, especially near apex of leaf; capsules hemispherical, lateral; spores 16–20  $\mu$  in diameter.

Ab *G. alpicola*, var. *rivularis* differt in foliis lanceolatis acuminatis papillosis.

This form resembles *G. apocarpa*, var. *gracilis* in general appearance but the short capsules and large spores indicate a closer relationship with the subsection *Alpicolae* through *G. alpicola* var. *rivularis*.

On rocks, in shade, Amesbury, Massachusetts, J. W. Huntington, September 1, 1901 (type in Herb. Grout).

5b. Var. *LATIFOLIA* (Zett.) Möller, Bot. Not. 143. 1907.

*Grimmia apocarpa*, f. *latifolia* Zett. Rev. Grimm. 53. 1861.

*Grimmia platyphylla* Mitt. Journ. Linn. Soc. 8: 20. 1865.

*Grimmia apocarpa*, var. *latifolia* Bergg. K. Sv. Vet.-Akad. Handl. 13: 48. 1875.

*Grimmia apocarpa*, var. *platyphylla* Lindb. Meddel. Soc. Fenn. 13: 253. 1886.

*Schistidium alpicola*, var.  $\gamma$  *latifolium* Limpr. Laubm. 1: 709. 1889.

Plants in loose tufts, 2–3 cm. high; stems simple or nearly so, radiculose at base; central strand well developed; *leaves* not recurved when moistened, *broadly ovate*, 2 mm. long, 0.7–1 mm. wide, obtuse, entire, concave, with strongly revolute margins; costa strong; calyptra cucullate; spores 15–20  $\mu$  in diameter.

Type locality, European.

ILLUSTRATIONS.—Roth, Eur. Laubm. 1, *pl.* 31; Engler & Prantl, (Ed. 2), 10, *fig.* 252 G-M. *Pl.* 2.

EXSICCATI.—Macoun, Can. Musci, Rocky Mts., 1890.

This is an Arctic-alpine variety known in North America from the mountains of Greenland, British Columbia, Alberta and Utah. It is distinguishable from all other members of the subgenus *Schistidium* by the broad leaves, which, except for the revolute margins, bear a strong resemblance to those of *Grimmia mollis*.

6. GRIMMIA APOCARPA [L.] Hedw. Sp. Musc. 76. 1801.

*Bryum apocarpum* L. Sp. Pl. 1115. 1753.

*Grimmia apocaulos* Lam. & DC. Fl. Fr. (Ed. 1) 1: 458. 1805.

*Grimmia fasciculata* Brid. Mant. 33. 1819.

*Grimmia apocarpa*  $\alpha$  *vulgaris* Hartm. Skand. Fl. ed. 1, 387. 1820.

*Grimmia strigosa* Brid. Bryol. Univ. 1: 171. 1826.

*Grimmia fusca* Nees, Hornsch. & Sturm, Bryol. Germ. 120. 1827.

*Schistidium apocarpum* Bryol. Eur. 3: (fasc. 25–28) 7. 1845.

*Grimmia apocarpa*, f. *vulgaris* Zett. Rev. Grimm. Scand. 52. 1861.

*Grimmia platyphylla* Stirt. Scott. Nat. 27: 219. 1890. Not Mitt. 1865.

*Schistidium apocarpum*, subsp. *vulgare*, Loeske, Laubm. Eur. 1: 26. 1913.

*Grimmia gracillima* Bartr. Bryologist 27: 72. 1924.

Plants variable in habit, usually growing in small, loose, dark or olive green tufts; stems erect or ascending, branched, 1.5–2.5 cm. high, round in cross section with an indistinct central strand; leaves 1.5–2 mm. long, imbricated, 2½–4 times as long as wide, strongly costate and usually more or less carinate, somewhat obtuse, erect-spreading when moist, ovate-lanceolate, bistratose in the upper half and on the margins; margins narrowly recurved; hair points usually short, somewhat spinulose, sometimes absent; costa distinct, not papillose on the back, often more or less channelled; leaf cells incrassate, somewhat sinuose, the upper ones

roundish quadrate, 9–10  $\mu$  in diameter, those at the base rectangular; perichaetial leaves larger and thinner with short broad points, and the basal cells hyaline. Autoicous; seta erect, stout, about 0.5 mm. long; capsule immersed, ovoid-ellipsoid, reddish brown, about 1 mm. long, wide mouthed when empty, the wall cells 4-stratose; columella attached to the lid and falling with it; lid red, short beaked; stomata few, indistinct or obsolete, mostly at the base of the capsule; calyptra mitrate, 0.75 mm. long; peristome teeth reddish, linear-lanceolate, cribose or entire, papillose, reflexed-revolute when dry and mature; spores reddish, smooth, 8–12  $\mu$  in diameter, spring to summer.

Type locality, "An Steinen um Schiffenberg bei Giessen" (Germany). Discovered by Dillenius.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 233; Jennings, Mosses of Western Penn. *pl.* 14; Braithw. Brit. Moss Fl. 2, *pl.* 46 C; Dixon, Handb. Brit. Mosses, (Ed. 3) *pl.* 17 H; Roth, Eur. Laubm. 1, *pl.* 29, 31; Grout, M. H. M. *pl.* 18; Loeske, Laubm. Eur. 1913, *figs.* 1a, 2b, 4, 5; Grout, Moss Fl. N. Y. City, *pl.* 3, *fig.* 2.

EXSICCATI.—Drumm. Musc. Am. 54; Sull. Musc. Allegh. 138; Holz. Musci Acro. Bor.-Am. 20, 361, 378 (distributed as *G. atricha*); Macoun, Can. Musci 77a; Allen, Mosses Casc. Mts. 26; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 133.

Alaska to Greenland and Newfoundland, southward to California, Arizona, New Mexico and Georgia. Europe. Asia. Africa. This is one of the most polymorphous species of the genus, and it is often impossible to place, with any degree of certainty, specimens of some of the variations.

6a. Var. NIGRESCENS Mol. Moosst. Alg. Alp. 70. 1865.

Forma *nigrescens* Moenk. Laubm. Eur. 348. 1927.

This variety differs from the typical *G. apocarpa* by its blackish color and narrower linear-lanceolate leaves. The cell walls are strongly thickened so that the cells appear to be smaller than they are in the typical form of the species. The leaves are unistratose but are much darker color in the upper half.

It most closely resembles the var. *gracilis* and is listed as a synonym of that variety under the name, *Schistidium gracile* by Limpricht,\* though erroneously so. The var. *atrata* should be included, in all probability, with the var. *nigrescens*.

Type locality, European.

EXSICCATI.—Table Top Mountain, Gaspé County, Quebec, Canada, J. F. Collins, 4436b., August 7, 1906.

6b. Var. BRUNNESCENS (Limpr.) Moenk. Laubm. 349. 1927.

*Schistidium brunnescens* Limpr. Laubm. 1: 714. 1889.

*Grimmia brunnescens* Paris, Index Bryol. (Ed. 1) 520. 1895.

*Schistidium apocarpum*, subsp. *confertum*, var. *brunnescens* Loeske, Laubm. 37. 1913.

*Schistidium apocarpum*, subsp. *brunnescens* Loeske, Mon. Eur. Grimm. 62. 1930.]

Close to var. *conferta*; median and upper leaves ovate or lance-ovate, 0.7–1 mm. long, plane or concave, not keeled; margins plane; capsule ovoid-globose; peristome teeth cuneiform, cribose or cleft.

Type locality, "an sonnigen Kalkfelsen des Kalenderberges bei Mödling nächst Wien" (Austria). Collected by J. Juratzka on April 14, 1872.

On sandstone, Minnesota and Wisconsin.

ILLUSTRATIONS.—Limpr. Laubm. Eur. 1, *fig.* 192; Roth, Eur. Laubm. 1, *pl.* 30; Loeske, Laubm. Eur. 1913, *fig.* 9e.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 379; Trempealeau Mts., Wisconsin, Oct. 25, 1903, Holzinger.

6c. Var. ATROFUSCA (Schimp.) Husn. Musc. Gall. 123. 1884.

*Grimmia atrofusca* Schimp. Syn. (Ed. 2) 240. 1876.

Plants in small, roundish, blackish green cushions 1–3 cm. high; leaves ovate-lanceolate, bistratose and blackish green in the upper half, obtuse, muticous, or with very short hyaline apices; margins plane in the upper half of the leaf, revolute below; costa subpercurrent; capsule small, ovoid; lid beaked; calyptra mitrate; annulus none; peristome teeth short, truncate, papillose.

Type locality, Rigi, Switzerland. Collected by Schimper.

On boulders and rocky ledges, New Mexico; Tennessee. Europe.

\* Limpr. Laubm. 1: 706. 1889.

ILLUSTRATIONS.—Limpr. Laubm. Eur. 1, fig. 191; Roth, Eur. Laubm. 1, pl. 29, 30; Loeske, Laubm. Eur. 1913, fig. 9d.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 664; Bartram 77, 78, 79, 97; Sharp, August 1, 1930.

6d. Var. *TENERRIMA* Nees, Hornsch. & Sturm, Bryol. Germ. 1823.

*G. apocarpa*, f. *tenera* Zett. Rev. Grimm. Scand. 33. 1861.

*Grimmia apocarpa*, var. *filiformis* Lindb. Oefv. af. K. Sv. Vet.-Akad. Foerh. 23: 552. 1866.

*Grimmia tenera* Zett. Musc. et. Hepat. Finm. 17. 1876.

*Grimmia apocarpa*, f. *tenerrima* Chal. Grimm. Tatr. 21. 1882.

*Schistidium apocarpum*, var. *tenerum* Conr. et. Hag. Chr. a Vid. Saelsk. Foerh. 11. 1893.

*Schistidium tenerrimum* Roth. Eur. Laubm. 1: 394. 1904.

*Grimmia conferta* var. *tenera* Hag. D. K. N. Vid. Selsk. Skrift. 60. 1909.

Very slender plants in thick, fragile, brownish tufts; stems filiform, numerous, crowded, 1.5–3 cm. long; leaves 0.75–1 mm. long, imbricated when dry, erect-patent when moist, ovate or ovate-lanceolate, the lower ones muticous, the upper with short, more or less denticulate hyaline points; upper and median cells roundish-quadrate, sinuate, incrassate, 5–7  $\mu$  in diameter; basal cells rectangular near the costa, quadrate towards the margin; capsule very small, almost globose; lid rostrate; spores 8–9  $\mu$  in diameter; peristome teeth cribrate and irregularly 2–3-cleft.

Type locality, European.

On rocks, Greenland and the Rocky Mountains.

ILLUSTRATIONS.—Roth, Eur. Laubm. 1, pl. 50.

EXSICCATI.—Thermometer Fjeld, n. e. Greenland, Andr. Lundager 932; on rocks, Moose Mts., Rocky Mountains, Macoun, Can. Musci 235a.

6e. Var. *pulvinata* (Hedw.) n. comb.

*Gymnostomum pulvinatum* Hedw. Sp. Musc. 36. 1801.

*Schistidium pulvinatum* Brid. Mant. 21. 1819.

*Anictangium flaccidum* DeNot. Mem. Acad. Torin. 38: 254. 1836.

*Grimmia sphaerica* Schimp. Stirp. Norm. 1844.

*Anodon pulvinatus* Rabenh. Deutschl. Kryptfl. 2: 154. 1848.

*Grimmia Hoffmanni* C. Muell. Syn. 1: 780. 1849.

*Grimmia flaccida* Lindb. Musc. Scand. 30. 1879.

*Grimmia subflaccida* Kindb. Ottawa Nat. 14: 85. 1900.

*Schistidium apocarpum*, subsp. *pulvinatum* Loeske, Mon. Eur. Grimm. 61. 1930.

Plants in small, round, dense, hoary tufts; stems blackish at base, 0.5–1.5 cm. high with a poorly developed central strand; leaves unistratose, imbricated when dry, erect-spreading when moist; lower leaves small, ovate, muticous, obtuse; upper leaves larger, concave, ovate-lanceolate, with a more or less developed, almost smooth, broad hair point; leaf-margins near the middle of the leaf narrowly revolute, 2–3-stratose; costa prominently convex on the dorsal side of the leaf, less distinct in apex; leaf cells incrassate, not papillose, the upper roundish quadrate, 7–9  $\mu$  in diameter, those at the base rectangular or quadrate; perichaetial leaves larger, hyaline at the base. Autoicous; seta erect, straight, about 0.5 mm. long; capsule immersed, subglobose, yellowish brown, wrinkled and turbinate when dry and empty; calyptra very small, mitrate, 3–5-lobed at the base; lid mamillate; annulus persistent, of 2 rows of small cells; stomata few or obsolete, at base of capsule; peristome rudimentary or absent; spores smooth, yellowish, 7–10  $\mu$  in diameter.

Type locality, Reinhausen, near Göttingen, Germany. Discovered by G. F. Hoffmann.

ILLUSTRATIONS.—Bryol. Eur. pl. 231; Roth, Eur. Laubm. 1, pl. 30; Hedw. Sp. Musc. pl. 3.

EXSICCATI.—New Brunswick, Macoun in 1889.

6f. Var. *GRACILIS* (Schleich.) Web. & Mohr. Bot. Taschb. 131. 1807.

*Grimmia gracilis* Schleich. Catalogus Helv. (Ed. 2) 29. 1807.

*Grimmia Schleicheri* Spreng. Einleit. Stud. Krypt. Gew. 277. 1804.

*Grimmia stricta* Turn. Musc. Hib. 20. 1804.

*Grimmia trichodon* Brid. Bryol. Univ. 1: 171. 1826.

- Grimmia apocarpa*, var.  $\gamma$  *Schleicheri* Brid. l. c. 169.  
*Schistidium apocarpum*, var.  $\beta$  *gracile* Bryol. Eur. 3: (fasc. 25-28) 7. 1845.  
*Schistidium gracile* Limpr. Laubm. 1: 705. 1889.  
*Grimmia longidens* Phil. Rev. Bryol. 25: 78. 1898.  
*Schistidium longidens* Culmann, Verz. Laubm. Kant. Zurich, 28. 1901.  
*Schistidium nodulosum* Stirt. Ann. Scot. Nat. Hist. 16: 175. 1907.

Plants in slender, loose, spreading mats 4-10 cm. long, dark green; stems spreading, rigid, dichotomously branched, slender, dark reddish brown, leafy above, leafless at base, angled in cross section; central strand usually lacking; leaves loosely imbricated, erect-spreading when moist, or often more or less secund, lanceolate, acuminate, carinate, hair pointed, 1.5-2 mm. long, often denticulate at apex; margins revolute, bistratose; costa prominent on the dorsal side of the leaf, often somewhat denticulate or papillose near the apex; leaf cells incrassate, sinuose, 6-9  $\mu$  in diameter, quadrate or rectangular at the base of the leaf; perichaetial leaves larger, more or less secund. Autoicous; seta straight, one-half or less the length of the capsule, swollen at the base; capsule ellipsoid, 1-1.3 mm. long; wall cells in regular rows, roundish-quadrate; calyptra mitrate, rarely cucullate; lid with a short, straight beak; annulus none; stomata small, numerous; peristome teeth 0.3 mm. long, cuneiform, orange, papillose, articulate; spores 10-15  $\mu$  in diameter, granulose.

Type locality, Switzerland. Discovered by Schwaegrichen.

On rocks from Nova Scotia and Quebec to British Columbia, southward to Arizona, Tennessee, and West Virginia.

ILLUSTRATIONS.—Schwaegr. Suppl. 1<sup>1</sup>, pl. 23; Bryol. Eur. pl. 234b; Roth, Eur. Laubm. 1, pl. 29, 50; Loeske, Laubm. Eur. 1913, fig. 6.

EXSICCATI.—Holz. Musci. Acro. Bor.-Am. 361; Macoun, Can. Musci 89, 90, 238, 237a, 86; Allen, Mosses Casc. Mts. 24, 25; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 134; Sull. Musc. Allegh. 136.

6g. Var. CONFERTA (Funck) Spreng. in Linn. Syst. Veg. (Ed. 16) 4: 153. 1827.

- Grimmia conferta* Funck, Moostach. 18. 1821.  
*Grimmia latifolia* Brid. Bryol. Univ. 1: 162. 1826.  
*Grimmia glacialis* Nees, Hornsch. & Sturm, Bryol. Germ. 2: 118. 1827.  
*Schistidium confertum* Bruch & Schimp. Bryol. Eur. 3: (fasc. 25-28) 7. 1845.  
*Grimmia pruinosa* Wils., in Schimp. Syn. ed. 2, 241. 1876.  
*Grimmia subincurva* Aust. Bot. Gaz. 3: 31. 1878.  
*Grimmia Brandegei* Aust. Bull. Torr. Club 6: 45. 1879.  
*Grimmia conferta*, var. *pruinosa* Braithw. Brit. Moss Fl. 2: 7. 1880.  
*Grimmia conferta*, var. *compacta* Lesq. & James, Man. Mosses N. Am. 135. 1884.  
*Grimmia plagiopodia*, var. *pilifera* Lesq. & James, l. c. 138.  
*Grimmia apocarpa*, var. *pruinosa* Husn. Musc. Gall. 123. 1886.  
*Grimmia apocarpa*, subsp. *conferta* Dixon, Stud. Handb. Brit. Mosses, (Ed. 1) 132. 1896.  
*Schistidium apocarpum*, subsp. *confertum*, Loeske, Laubm. Eur. 1: 35. 1913.  
*Schistidium apocarpum*, var. *confertum* Möller, Arkiv. för Bot. 24: 33. 1931.

Plants in small, dense, fragile, dull green, or more or less grayish cushions, 1-2 cm. high; central strand of the stem distinct; leaves lanceolate or ovate-lanceolate, with a short spinulose hair-point, keeled, 0.7-1 mm. long; margins strongly revolute, more or less bistratose above; capsule thin-walled, ovoid-hemispherical; peristome teeth cleft or cribose, coarsely papillose, orange.

Type locality, collected by Heinrich Funck in the Fichtel Gebirge, alt. 400 m., near Berneck, Germany.

On dry rocks, Nova Scotia and Quebec to Yukon, southward to California and North Carolina. When this variety occurs on limestone, the tufts have a brownish tinge and the plants resemble somewhat those of the var. *brunnescens*. The forma *obtusifolia* (Bryol. Eur.) Moenk. (var. *obtusifolia* Bryol. Eur.) occurs in moist habitats. The leaves are shorter and broader, obtuse, mucous, or with short hyaline points.

ILLUSTRATIONS.—Bryol. Eur. pl. 232; Braithw. Brit. Moss Fl. 2, pl. 46a; Dixon, Handb. Brit. Mosses, (Ed. 3) pl. 17 I; Roth, Eur. Laubm. 1, pl. 30; Grout, M. H. M. fig. 53.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 21, 282; Macoun, Can. Musci 84, 91; Bartram 592, 34, 508, 23; Collins 4621, 4878, 4947; Flowers 1047, 1100; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 135, 136; Sull. Musc. Allegh. 139.

6h. Var. *ambigua* (Sull.) n. comb.*Schistidium ambiguum* Sull. Mem. Amer. Acad. Sci. 4: 170. 1849.*Guembelia ambigua* C. Muell. Syn. 2: 649. 1851.*Grimmia ambigua* Sull. Icon. Musc. 1: 66. 1864.

Plants small, *densely pulvinate*, grayish green; stems erect, 0.5–1 cm. high or sometimes spreading and up to 3 cm. long; leaves appressed when dry, erect-spreading when moist, lanceolate or ovate-lanceolate, variable in shape and size; lower leaves smaller, usually muticous; *hair point* hyaline, denticulate, *about 1/3 or more the length of the upper leaves*; costa strong, prominently convex on the dorsal side of the leaf; *margins plane*; cells not, or scarcely sinuose, the upper and median ones roundish-quadrate, 6–8  $\mu$  in diameter; basal cells quadrate or rectangular; *perichaetial leaves larger, strongly differentiated*, oblong-lanceolate. Autoicous; seta erect, straight, 1 mm. long; *capsule* 1–1.5 mm. long, erect, immersed, *ellipsoid-cylindrical*, smooth; *calyptra often cucullate*, about 0.75 mm. long, reaching to the base of the lid; lid rostellate; peristome teeth reddish, strongly papillose, lanceolate, entire or cleft, erect or spreading when dry; *spores* 6–8  $\mu$  in diameter, smooth.

Type locality, dry rocks, Santa Fé, New Mexico, collected by Fendler.

New Jersey, Pennsylvania, Utah, Colorado, Arizona, New Mexico; Washington, Idaho. This variety differs from typical *G. apocarpa* in its longer hyaline leaf points and the often cucullate calyptra.

ILLUSTRATIONS.—Sull. Icones Musc. pl. 41; Grout, M. H. M. fig. 54.

EXSICCATI.—Bartram 45, 30, 829, 1556, 44, 877; Flowers 1035; Aust. Musc. Appal. 142.

## 7. GRIMMIA HETEROPHYLLA Kindb. Mac. Cat. Can. Pl. 6: 64. 1892.

*Grimmia concinodontooides* Kindb. Bull. Torr. Club. 17: 271. 1890.*Grimmia concinodontooides* Kindb.; Mac. Cat. Can. Pl. 6: 64. 1892.*Grimmia chloroblasta* Kindb. l. c.

Plants dark green, *loosely tufted*; stems numerous, *spreading, more or less elongated*, simple below, forked above, 3–10 cm. long; leaves loosely imbricated when dry, erect-spreading when moist, lanceolate, sheathing at the base, concave, opaque in the upper part, 1–1.5 mm. long, acuminate; *margins plane*; costa flat, not prominent; *hair points of the upper leaves one-third or more the length of the leaf*, hyaline, more or less spinulose; upper leaf-cells dense, chlorophyllose, opaque, roundish, 5–6  $\mu$  in diameter, basal cells more or less hyaline, those near the costa linear or rectangular, those towards the margin quadrate with the cross walls thicker; *perichaetial leaves strongly differentiated, much larger*, 2 mm. long with hair points 1–2 mm. long. Autoicous (?); seta straight, shorter than the capsule; *capsule* immersed, 1 mm. long, *semi-ovoid*; *calyptra cucullate*; peristome teeth subulate-lanceolate, scarcely papillose; *spores* 9–11  $\mu$  in diameter, granulose.

Type locality, "On rocks on the mountains between the Nicola and Thompson rivers at Spence's Bridge, B[ritish] C[olumbia], alt. 3,500 feet, May 28th, 1889." Collected by John Macoun.

ILLUSTRATIONS.—Pl. 1.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 364; Macoun, Can. Musci 607, 246 (dup. type).

On rocks, British Columbia and Washington. This species is of uncertain affinity. Although the characters of the sporophyte are undoubtedly those of the subgenus *Schistidium*, the leaves bear some resemblance to those of some species of the *Litoneurum* group of *Orthogrimmia*.

## Subgenus 2. COSCINODON (Spreng.)

*Coscinodon* Spreng. Einleit. Stud. Krypt. Gew. 281. 1804, as genus.

Capsules symmetrical; seta straight; stomata usually present, often large; columella free from the lid and persistent; calyptra large, covering most of the capsule, campanulate-mitrated, plicate; peristome teeth decidedly cribose; leaves imbricated when dry; margins usually plane or nearly so; hyaline points usually long; basal leaf cells rectangular or quadrate, smooth-walled; costa strong.

The general appearance of this group is somewhat distinctive but there are no important morphological characters to entitle it to generic status. The leaves usually have long hyaline points, the margins are usually plane or nearly so, and the basal cells are smooth-walled. However, the two chief criteria that are relied upon to distinguish *Coscinodon* as a genus are the cribose peristome teeth and the large plicate calyptrae. But cribose teeth, like plane-margined leaves with well developed hyaline points and smooth-walled basal

cells, are by no means confined to this group. The conspicuous calyptra is the only remaining taxonomic character. This organ shows, throughout the Grimmiaceae, such a wide intrageneric variation that as a generic character it has little or no phylogenetic significance. It is not altogether improbable that the procedure of some of the earlier bryologists of uniting all the species of the Grimmiaceae into one genus is one that will ultimately have to be adopted.

8. GRIMMIA WRIGHTII Aust. Bull. Torr. Club. 6: 46. 1875.

*Coscinodon Wrightii* Sull. Mosses U. S. 38. 1856.

Plants in small, dense, compact, pale green tufts; stems 0.5–1.5 cm. high, branched above, few-leaved and with some rhizoids at base; *leaves* numerous, crowded, imbricated when dry, erect-patent when moist, *ovate* or *obovate*, cochleariform, *non-plicate*; margins plane, *erose-denticulate above the middle*; costa stout, less canaliculate on the upper surface, running out into a stout, terete, somewhat spinulose, hyaline hair-point; upper and median cells oblong or oval, those near the apex often more or less hyaline; basal cells rectangular or quadrate. *Autoicous*; *seta much shorter than the capsule*, straight, erect; capsule immersed, ellipsoid or cylindrical, truncate at the base, smooth when dry; annulus present, deciduous in fragments; peristome teeth cuneiform, reddish, cribose and 2–3-cleft at the apex into slender divisions; lid shortly straight beaked, the beak equalling the basal diameter; calyptra mitrate, strongly plicate, covering the capsule to the middle or below; spores in winter.

Type locality, on rocks, near San Marcos, Texas, collected by Wright.

Minnesota to Texas, New Mexico, Arizona, Utah and Colorado.

ILLUSTRATIONS.—Sull. Icones, *pl. 45*; Sull. Mosses U. S. *pl. 4*; *Pl. 3*.

EXSICCATI.—Holz. 39; Bartram 3; Flowers 505; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 132, (Ed. 2) 197; R. & C. Musc. Am. Sept. 173.

9. GRIMMIA RAUI Aust. Bull. Torr. Club. 6: 46. 1875.

*Coscinodon Renauldi* Card. Bot. Gaz. 15: 41. 1890.

Plants in small, compact, gray or greenish tufts; stems erect, simple or dichotomously branched, 3–10 mm. high; *leaves* small, imbricated when dry, erect-patent when moist, *obovate*, *spatulate*, or *ovate*, 0.75–1 mm. long; *margins* plane, *entire*; costa stout, more or less canaliculate on upper surface, extending out into a stout, terete, somewhat spinulose, hyaline hair-point; upper cells roundish-quadrate, chlorophyllose, thick-walled; basal cells loose, more or less hyaline, quadrate or rectangular, with the cross walls thicker than the long walls. *Autoicous*; *seta much shorter than the capsule*, straight, erect; capsule immersed, globose when young, becoming ellipsoid or cylindrical, truncate at the base, smooth, 1 mm. long; lid conical; annulus of 2 rows of cells; peristome teeth slender, cribose below the middle, cleft into 3–4 coherent divisions above, densely papillose and granulose; calyptra large, mitrate, strongly plicate, covering the capsule to the middle or below.

Type locality, Colorado. Collected by Brandegee.

Usually on sandstone, Minnesota and South Dakota to Utah, Colorado, Kansas, and Oklahoma.

ILLUSTRATIONS.—Bull. Torr. Club 22: *pl. 248*; *Pl. 4*.

EXSICCATI.—On exposed sand ledges and boulders at the tops of the bluffs 400 ft. above the Mississippi River near Winona, Minn. Holz. 38; Price, Utah, *Flowers* 807, 808; R. & C. Musc. Am. Sept. 34b.

10. GRIMMIA CRIBROSA Hedw. Sp. Musc. 76. 1801.

*Coscinodon pulvinatus* Spreng. Einleit. Stud. Krypt. Gew. 281. 1804.

*Coscinodon Persoonii* Hampe, Flora, 280. 1837.

*Coscinodon cribrosus* Spruce, Ann. Mag. Nat. Hist. 2nd Series, 3: 491. 1849.

Plants in thick, broad, low, grayish or blackish-green tufts; stems 1–2 cm. high, with rhizoids at base; central strand poorly developed; *leaves* numerous, crowded, imbricated when dry, erect-patent when moist, the upper ones larger, *ovate* or *lanceolate*, bistratose in upper half and *with prominent plicae on each side of the costa*; hyaline points long, slightly denticulate; costa prominently convex on the dorsal surface of the leaf, more or less canaliculate on the upper surface; margins entire, plane or revolute in upper part of leaf;

cells smooth, not sinuate, upper and median chlorophyllose, roundish-quadrate, 8–10  $\mu$  in diameter, the lower cells looser, quadrate or rectangular, more or less hyaline, at least at base; perichaetial leaves larger. *Dioicous*; seta 0.5–1 mm. long, yellowish-green, twisted to the left; capsule erect, or the older ones somewhat cernuous, yellowish-green, immersed, ovoid, wide-mouthed when dry and empty, smooth; calyptra campanulate-mitrate, plicate, covering most of the capsule, lobed at base, thin; lid shortly straight-beaked; annulus present, persistent; stomata in one row near the base of the capsule; peristome teeth lanceolate, about 0.5 mm. long, orange-red, densely papillose, very cribose; spores smooth, yellowish, 8–12  $\mu$  in diameter, in spring.

Type locality, "bei Goslar am Oberharze" (Germany), discovered by Persoon.

On sunny, non-calcareous rocks in the mountainous regions of western North America, in Alaska, British Columbia, Idaho, and Arizona; Greenland. Also in Europe and Asia. Although this species resembles *G. anodon*, the asymmetrical capsule, absence of peristome, the smaller calyptra, and the non-plicate leaves of that species readily separate it.

ILLUSTRATIONS.—Bryol. Eur. pl. 230; Limpr. Laubm. 1, fig. 104; Broth. Musci Fenn. fig. 34A–F; Braithw. Brit. Moss Fl. 2, pl. 53A; Dixon, Handb. Brit. Mosses, (Ed. 2), pl. 21F; Roth, Eur. Laubm. 1, pl. 35, 50; Engler & Prantl, Musci, (Ed. 2), 10, fig. 252A–F; Loeske, Laubm. Eur. 1913, figs. 2c, 15, 32c; Pl. 2.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 482; Bartram 59, 96.

## II. GRIMMIA CALYPTRATA Hook. in Drumm. Musc. Bor. Am. No. 60, 1828.

*Guembelia calyptrata* C. Muell. Syn. 1: 775. 1845.

*Coscinodon Hookeri* Hampe, in Jaeger & Sauerb. Adumbr. 1: 377. 1872.

*Coscinodon calyptratus* Kindb. Eur. & N. Am. Bryin. 241. 1897.

Plants in loose, roundish tufts, appearing conspicuously silvery-gray with the long, hyaline points of the leaves; stems erect, robust, branched, 1.5–2.5 cm. high; central strand rudimentary; leaves imbricated when dry, erect-spreading when moist, non-plicate, the lower leaves smaller and muticous; upper leaves larger, lanceolate, unistratose, except on the margins, 1.5–3 mm. long; hyaline hair point sparingly denticulate,  $\frac{1}{2}$ –2 times the length of the lamina; costa strong, prominently convex and often slightly 2-ridged on the dorsal side of the leaf; margins bistratose, plane, or one slightly recurved; cell walls not sinuose, the cells distinct, the upper roundish, 6–8  $\mu$  in diameter; basal cells quadrate or rectangular; perichaetial leaves larger with very long hair points. *Dioicous*; seta erect, straight, 2–3 mm. long; capsule 1.5–1.75 mm. long, erect, exerted, ellipsoid or cylindrical, slightly constricted under the mouth when dry and empty, smooth, or somewhat striate, brown; calyptra 2–2.5 mm. long, plicate, lacerate at base, campanulate-mitrate or cucullate, covering the capsule nearly to the base; lid straight-beaked, usually falling with the calyptra, beak 1 mm. long; stomata none; annulus none; peristome teeth reddish, deeply cleft into slender divisions, finely papillose; spores 10–12  $\mu$  in diameter, yellowish, granulose, in spring.

Type locality, "ad rupes in Rocky Mountains." [Canada] Collected by Drummond.

ILLUSTRATIONS.—Sull. Icones, pl. 44; Pl. 3.

EXSICCATI.—Macoun, Can. Musci 96, 272, 472; Drumm. l. c.; Holz. Musci Acro. Bor.-Am. 209; Baker, Pac. Slope Bry. 114; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 139, (Ed. 2) 211; R. & C. Musc. Am. Sept. 217.

On basalt, granite, quartzite, sandstone, limestone, and other rocks in the Rocky Mountain region from British Columbia and Alberta to California and New Mexico. In many places in this region it is abundant. It is a pronounced xerophyte.

The conspicuous straw colored calyptra, the densely canescent tufts, and the smooth, brown capsules which are slightly constricted under the mouth when dry, render this species of easy determination. It usually fruits abundantly.

### Subgenus 3. EUGRIMMIA C. Muell. Syn. 2: 783, 1851, emend.

Capsule usually symmetrical and emergent or exerted, shorter than the seta (or if immersed and longer than the seta, columella not as in *Schistidium*), smooth, or longitudinally sulcate when dry; seta straight or arcuate; sheath ovoid or ellipsoid; columella free from the lid and persistent; calyptra mitrate or cucullate, smooth, non-plicate, not completely covering the capsule; peristome teeth more or less perforated or cleft, but not decidedly cribose, or peristome sometimes lacking; leaves usually imbricated, rarely crisped, and not spirally twisted around the stem when dry; gemmae usually absent.

- Seta straight or nearly so, and nearly always longer than the capsule, or if arcuate, shorter than the ventricose capsule; capsule not longitudinally sulcate when dry.....Section 1. Orthogrimmia.
- Seta arcuate or flexuose, at least when moist, longer than the symmetrical capsule which is often longitudinally sulcate when dry.....Section 2. Rhabdogrimmia.

## Section 1. ORTHOGRIMMIA (Schimp.)

*Orthogrimmia* Schimp. Coroll. Bryol. Eur. 48. 1856, as subgenus.

Capsule erect, not longitudinally sulcate when dry, either symmetrical on a long, straight seta, or gasterocarpous on a short, arcuate seta; columella free from the lid and persistent; calyptra non-plicate; leaves not crisped or spirally inrolled when dry.

## Subsection 1. HYDROGRIMMIA (Hagen)

*Hydrogrimmia* Hagen, Kong. Norske Vidensk. Selsk. Skrift. 1909, No. 5: 35. 1909, as subgenus.

*Hydrogrimmia* Loeske, Morph. und System. Laubm. 108. 1910, as genus.

Capsule exserted, shorter than the seta, smooth; stomata none; seta straight; calyptra small, evanescent, cucullate. Dioicous; leaves unistratose, ovate-lanceolate, obtuse, concave, not keeled; margins plane; median and upper leaf cells 12–15  $\mu$  in diameter; hydrophytic.

Since the genus *Hydrogrimmia* rests solely on leaf characters, it seems best to follow Bruch & Schimper, Limpricht, and others in including it with the genus *Grimmia*. *G. mollis* is the only species in this subsection. Although of very different appearance, it lacks fundamental characters of generic value. The sporophyte is essentially grimmaceous; the gametophyte is characteristically hydrophytic.

## 12. GRIMMIA MOLLIS Bryol. Eur. 3: (fasc. 42) 1, 1849.

*Grimmia orthotrichoides* Hartm. Skand. Fl. (Ed. 5), 378. 1849.

*Hydrogrimmia mollis* Loeske, Morph. und System. Laubm. 108. 1910.

Plants in soft, loose, fragile, olive green tufts; stems branched from the base, 2–4 (10) cm. long, spreading, leafy above, radiculose below, round in cross section, central strand present; leaves soft, mucous, and more or less cucullate, 2–3 mm. long, 1 mm. wide, unistratose throughout, loosely imbricated when dry, ovate-lanceolate or oblong-lanceolate, obtuse, sometimes with a single hyaline end-cell, concave, not keeled; margins plane, not thickened; costa subpercurrent; cells chlorophyllose, not sinuose, the upper and median ones quadrate, 12–15  $\mu$  in diameter, basal cells shortly rectangular or quadrate; perichaetial leaves larger, loosely imbricated, with pellucid points. Dioicous; seta straight, 2–3 mm. long; capsule ovoid to almost cylindrical, shortly exserted, erect, smooth, yellowish brown; calyptra small, cucullate, evanescent; lid convex-apiculate; annulus not differentiated; stomata absent; peristome teeth reddish, papillose, cuneiform, spreading when dry, cribose or entire; spores olive green, finely granular, 10–13  $\mu$  in diameter, in summer.

Type locality, Norway, discovered by H. Holmgren.

ILLUSTRATIONS.—Bryol. Eur. pl. 253; Broth. Musci Fenn. fig. 33 I–M; Roth, Eur. Laubm. 1, pl. 33; Engler & Prantl, (Ed. 2) 10, fig. 256L–M; Loeske, Laubm. Eur. 1913, figs. 17m, 35a, 55; Pl. 4.

EXSICCATI.—Base of Sperry Glacier, Montana, altitude 6,500 feet, Holzinger & Blake, July 25, 1898. This is the first station for this species in North America.

The forma *aquatica* (Bry. Eur.) Moenk. (*G. mollis*, var. *aquatica* Bryol. Eur.; *G. mollis*, subsp. *submersa* Kindb.) is the robust, aquatic form which is usually sterile. It has been reported from Montana and Greenland.\*

On wet, non-calcareous rocks in alpine regions in Montana, Greenland, Europe, and Asia; seldom fruiting.

*Grimmia mollis* is an Arctic-alpine species which bears no superficial resemblance to any other member of the genus except the distantly related *G. alpicola*, var. *latifolia*. From this latter plant it may be distinguished by the leaves having strongly revolute margins and by means of the very different sporophyte.

\* Paris, E. G., Index Bryologicus (Ed. 2) 2: 279. 1904.

## Subsection 2. GASTEROGRIMMIA (Schimp.)

*Gasterogrimmia* Schimp. Syn. Musc. Eur. (Ed. 2) 245. 1876, as genus.

*Gastrogrimmia* Loeske, Mon. Eur. Grimm. 80. 1930, as Group A.

Capsules more or less ventricose at base; seta arcuate, usually shorter than the capsule; stomata present, often large; columella free from the lid and persistent; calyptra small, scarcely longer than the lid, cucullate or mitrate, non-plicate; peristome teeth more or less perforated or cleft, but not decidedly cribose, or peristome none; leaf margins plane; autoicous species (except *G. poecilostoma*).

## 13. GRIMMIA ANODON Bryol. Eur. 3: (fasc. 25-28) 8, 1845.

*Schistidium pulvinatum* Brid. Bryol. Univ. 1: 114. 1826. Not of Sm. 1807.

*Anodon ventricosus* Rabenh. Deutschl. Kryptfl. 2: 154. 1848.

*Grimmia alpina* Kindb. Enum. Bryin. Dovr. 30. 1888.

*Schistidium anodon* Loeske, Laubm. Eur. 1: 49. 1913.

Plants in small, black or grayish, fragile, cushion-like tufts 1-5 cm. wide; stems blackish and radiculose at base, 0.5-1.5 cm. high, slender, fragile, with distinct central strand; leaves loosely imbricated when dry, erect-spreading when moist, mostly bistratose, the lower small, ovate, muticous, the upper oblong or oblong-lanceolate, concave, plane margined, hair-pointed; upper cells roundish quadrate, incrassate, chlorophyllose, 8-10  $\mu$  in diameter, those at the base elongate-rectangular, hyaline; perichaetial leaves larger with longer hair points. *Autoicous*; seta shorter than the capsule, yellowish, arcuate, capsule small, immersed, subglobose, *ventricose* at base, smooth, *gymnostomous*; lid broad, mamillate; *calyptra mitrate*, 5-7-lobed at base; annulus simple; stomata present, large; spores yellow, smooth, 6-9  $\mu$  in diameter, in spring.

Type locality, Heidelberg, collected by A. Braun.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 236; Braithw. Brit. Moss Fl. 2, *pl.* 46E; Dixon, Handb. Brit. Mosses, (Ed. 3) *pl.* 17K; Roth, Eur. Laubm. 1, *pl.* 31; Loeske, Laubm. Eur. 1913, *figs.* 1b, 11, 12; *Pl.* 5.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 641; Bartram 36½, 38½; Flowers 813, 818, 793, 1031; R. & C. Musc. Am. Sept. 285.

On dry granite, quartzite, sandstone, limestone, and other rocks. New Brunswick; British Columbia and Saskatchewan to Arizona. In the Rocky Mountains it is apparently a very common species. The absence of the peristome, and the bistratose leaves distinguish this species from one of its near congeners, *G. plagiopodia*.

13a. forma *anomala* (Bartr.) n. comb.

*G. anodon*, var. *anomala* Bartr. Bryologist 27: 59. 1924.

Differs from the species in having the upper leaf cells unistratose.

Type locality, on shaded banks of dry washes, Tucson Mountains, Pima County, Arizona, collected by Bartram. Specimens examined: steep shaded banks of dry washes in Tucson Mountains, altitude 2300 feet, Pima County, Arizona, February 13, 1924, Bartram 931. Also Bartram 1602, 1361, 1340, 1186, 1707, 31, 97, 778, 938, 550; Holz. Musci Acro. Bor.-Am. 563.

## 14. GRIMMIA AMERICANA Bartr. Bryologist 32: 8. 1929.

Plants in compact, extensive mats, brownish below, deep dark green above and very hoary with the long hyaline leaf points; stems robust, 1-1.5 cm. long, rather fragile, fasciculately branched; leaves imbricated when dry, erect-spreading when moist, the lower ovate-lanceolate, obtuse, muticous, about 1 mm. long, 0.5 mm. wide at the broadest part; upper leaves 1.5-2 mm. long, 0.9 mm. wide just above the base, *broadly ovate*, concave, widest just below the middle, gradually tapering to the obtuse apex, prolonged into a long, hyaline, denticulate hair point which is terete at the apex and flat at the decurrent base; margins plane; costa flat, rather indistinct, somewhat thickened above, vanishing in the base of the hair point; *upper and median cells bistratose*, roundish-quadrate, densely chlorophyllose, 8-10  $\mu$  in diameter, incrassate; basal cells rectangular with lightly sinuose yellowish-pellucid lateral walls, quickly becoming quadrate toward the margins and decreasing in size upwards. *Autoicous*; antheridial bud sessile below the perichaetium; antheridia 12-15, without paraphyses; capsule immersed, ovoid-ellipsoid, reddish brown, *ventricose*

at the base, 1.3–1.5 mm. long without the lid; seta short, curved, about 0.4 mm. long; peristome teeth orange red, 1.5–1.7 mm. long, flat, often more or less united, split above into 3–4 papillose, linear divisions which are irregularly coherent, cribose in the middle and lower parts, showing 7–9 strong transverse articulations above the mouth; annulus about 2 cells high, falling in pieces with the lid; lid rostellate from a convex base, about 0.75 mm. long; *calyptra* *mitrate*, irregularly lobed at the base, reaching a little below the mouth of the capsule; spores 12–15  $\mu$  in diameter, pellucid, smooth.

Type locality, Fort Davis, Jeff Davis County, Texas, altitude 5,200 feet, May 22–25, 1926, C. R. Orcutt, 7082.

ILLUSTRATIONS.—Bryologist 32, pl. 1; Pl. 6.

EXSICCATI.—Bartram 47, 57, 134a, 143b, 201, 330, 335, 350, 511, 560, 572, 729, 1385, 1414, 1468; Orcutt 7082; Harris 30.

The foregoing description has been adapted from Bartram's very excellent original description. This species differs from *G. poecilostoma* in its autoicous inflorescence, the better developed peristome, the longer and straighter beaked lid, the more robust habit, and the broader leaves with longer hair points.

#### 15. GRIMMIA FLAGIOPODIA Hedw. Sp. Musc. 78. 1801.

*Grimmia obtusa* Brid.; Schrad. Bot. Journ. 1: 276. 1801.

*Grimmia plagiopus* Schwaegr. Suppl. 1: 95. 1811.

*Schistidium plagiopodium* Loeske, Laubm. Eur. 1: 52. 1913.

Plants in low, brownish green tufts; stems erect, 3–10 mm. high; central strand present; leaves mostly *unistratose*, imbricated, concave, the lower ovate, obtuse, the upper *ovate-lanceolate*, plane margined; hair points short, hyaline, denticulate; costa subpercurrent; cells thick walled, the upper somewhat irregular, roundish-quadrate, 10–12  $\mu$  in diameter, those at the base quadrate or rectangular, more or less hyaline; perichaetial leaves larger, with longer hair points, the basal cells pellucid. *Autoicous*; seta yellowish, arcuate, thicker at the base, shorter than the capsule; capsule immersed, inclined to one side, subglobose, more or less ventricose at one side at the base, brownish, 1 mm. long; *calyptra* *mitrate*, 0.75 mm. long; lid yellow, mamillate; annulus persistent, of 1–2 rows of cells; stomata large, at the base of the capsule; peristome teeth reddish, 2–5-cleft and cribose above the middle; spores smooth, yellowish, 11–13  $\mu$  in diameter, in spring.

Type locality, Saxony, discovered by von Flüge in 1798.

Chiefly on sandstone, British Columbia and Alberta to New Mexico and Missouri.

ILLUSTRATIONS.—Bryol. Eur. pl. 236; Limpr. Laubm. Eur. 1, fig. 195; Roth, Eur. Laubm. 1, pl. 31; Engler & Prantl, (Ed. 2) 10, fig. 257; Hedw. Sp. Musc. pl. 15; Loeske, Laubm. Eur. 1913, figs. 11, 13; Pl. 5.

EXSICCATI.—Macoun, Can. Musci 250, 250a; Bartram 539; Holz. Musci Acro. Bor.-Am. 510; Flowers 836.

#### 16. GRIMMIA MOXLEYI Williams, Holz. Musc. Acro. Bor.-Am. no. 600, Aug. 10. 1926.

and Bryologist 29: 63. 1926.

Plants in low, flat, tufts; stems 0.5–1 cm. long; central strand present; leaves closely imbricated when dry, erect-spreading when moist, oblong or *oblong-lanceolate*, *unistratose*, obtuse, concave, all but the perichaetial leaves *muticous*; margins plane, bistratose; costa prominent, often slightly canaliculate, shortly subpercurrent; median and upper leaf cells roundish-quadrate, 7–9  $\mu$  in diameter, those along the margins more or less transversely elongated, basal cells quadrate, the lowest becoming rectangular and hyaline; perichaetial leaves larger, with a spinulose, hyaline hair point, as long or longer than the leaf. *Autoicous*; seta arcuate, about 1 mm. long, yellowish; capsule erect, exserted, ovoid-ellipsoid, almost symmetrical, brown, faintly striate when dry, about 1 mm. long; *calyptra* *cucullate*, half as long as the capsule; lid conical; annulus of 3 rows of cells, deciduous; stomata large; peristome teeth inserted on the mouth of the capsule, narrow, reddish, strongly papillose, cuneiform, 2–3-cleft; spores smooth, yellowish, 9–11  $\mu$  in diameter.

Type locality, between Big Rock Creek and Devil's Punch Bowl, Los Angeles County, California. Collected by George L. Moxley, May, 1926.

This rare plant, is at present known only from southern California and Arizona. It is apparently somewhat closely related to the European *G. crinita* Brid., var. *capillata* De Not.

ILLUSTRATIONS.—Pl. 8.

EXSICCATI.—California: canyon of Mesquite Spring, Funeral Mountains, west of Amargosa, February 20, 1891, F. V. Coville 336; on rocks, Big Rock Creek, San Gabriel Mountains, April 27, 1921, G. L. Moxley;

on sandstone conglomerate between Big Rock Creek and Devil's Punch Bowl, Los Angeles County, May 30-31, 1926, *G. L. Moxley* 1141 (type collection). *Arizona*: Sacaton Mountains, Sacaton, Pinal County, December 15, 1926, *Puables & Harrison* 13.

17. GRIMMIA POECILOSTOMA (Card. & Seb.) Limpr. Laubm. 3: 713. 1902.

*Grimmia crinita*  $\times$  *leucophaea* Card. Rev. Bryol. 17: 18. 1890.

*Gasterogrimmia poecilostoma* Card & Seb. Rev. Bryol. 28: 118. 1901.

*Grimmia tergestina*, var. *poecilostoma* Loeske, Laubm. Eur. 1: 84. 1913.

Plants in loose, fragile, blackish green hoary tufts; stems erect, 5-10 mm. high, leafless and radiculose below; central strand present; *leaves* clustered toward the end of the stem, 1.3-2 mm. long, imbricated when dry, erect-ascending when moist, *opaque and bistratose in the upper half*, unistratose in the lower half, those at the base of the stem oblong or oblong-ovate, muticous, spreading when dry; upper and median leaves lanceolate, concave, hyaline at apex, and with a long, more or less spinulose hair point; margins plane or incurved below apex of leaf; median leaf cells roundish-quadrate, 6-8  $\mu$  in diameter, those at the base of the leaf toward the costa rectangular, marginal cells quadrate; perichaetial leaves larger. *Dioicous*; seta erect, straight or curved, shorter than the capsule; capsule immersed, erect, ellipsoid, brownish, smooth, somewhat wide-mouthed when dry and empty, gasterocarpous; *calyptra mirate*, several lobed at base; lid with a short straight or oblique beak; annulus broad, revolute, of 2-3 rows of cells; stomata in one row; peristome reddish, more or less reduced, the teeth truncate, irregularly cleft and cribrate, finely papillose; spores yellowish brown, smooth, 8-10  $\mu$  in diameter.

Type locality, "Auvergne bei Pont-de-Longue (Puy-de-Dôme)." Collected by F. Gasilien in 1888.

ILLUSTRATIONS.—Roth, Eur. Laubm. 1, *pl.* 52; Loeske, Laubm. Eur. 1913, *fig.* 22; Rev. Bryol. 28: *pl.* 5; *Pl.* 6.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 538; Bartram 102, 103, 104, 105, 109, 117, 150, 346, 1174, 1175, 1180, 1336, 1347; Orcutt 192.

On dry, sunny rocks chiefly granite, Arizona, New Mexico, Washington. The hypothesis that this plant may be a hybrid between *G. tergestina* and *G. anodon* lacks convincing evidence to support it, since *G. tergestina* is not known to occur in North America. For a discussion of the nomenclature of *G. poecilostoma* cf. article by J. M. Holzinger in the Bryologist 28: 7, 8, 1925.

Subsection 3. LITONEURUM (Hagen)

*Litoneurum* Hagen, Kong. Norske Vidensk. Selsk. Skrift. 1909, No. 5: 10. 1909, as subgenus.

Leaves not keeled, costa flattened, often somewhat obscure, not prominently convex on the dorsal surface of the leaf; margins usually plane or nearly so. *Dioicous*; capsule rarely asymmetrical and ventricose at base.

18. GRIMMIA GLAUCA Card. Rev. Bryol. 17: 17. 1905.

Plants in dense, glaucous green tufts, easily separating; stems simple, or branched from the base, 0.5-1.5 cm. long; *leaves* bright green, patent when moist, imbricated and dark green when dry, *lanceolate, gradually acuminate*, 4 or more times as long as wide, somewhat concave, opaque, about 2 mm. long, bistratose in the upper half, except on the margins, unistratose at the base; hair point 0.5-1 mm. long, spinulose; margins plane; cells rounded or sub-hexagonal, dense, chlorophyllose, fairly uniform in size throughout the leaf, except for a few nearly quadrate, somewhat larger, less opaque cells near the base of the leaf; *costa flat*, indistinct toward the apex of the leaf; sporophyte unknown.

Type locality, Charleville, France, collected by Cardot & Longuet.

ILLUSTRATIONS.—Bryologist 9, p. 29; *Pl.* 4.

EXSICCATI.—On a knoll strewn with limestone boulders 3 miles south of Lewiston, Minnesota, August 23, 1905, J. M. Holzinger 184; on erratic sand rock boulders in the creek running near Bohri's Valley, Wisconsin, May 12, 1906, J. M. Holzinger 184b; Little Long Creek, Albemarle, North Carolina, August 17, 1892, J. K. Small; on metamorphosed rocks, Long Canyon, Albany County, Wyoming, R. C. Collins 60.

This is apparently a rare plant in North America, where it is known only from Wyoming, Wisconsin, Minnesota, and North Carolina. Its taxonomic status is rather uncertain. The suggestion has been made

that it is a hybrid, but its geographical distribution indicates that this is improbable. For further discussion see Holzinger, *Bryologist* 9: 29-31, 1906, and Loeske, *Die Laubmoose Europas* 1: 79, 1913, and *Monographie der europäischen Grimmiaceen* 95, 1930.

*G. glauca* may be distinguished from *G. laevigata* by means of the following characters: leaves opaque, gradually acuminate, nearly uniform in size so that the lower ones are not strongly reduced as are those of *G. laevigata*, lanceolate, not broadly ovate or deltoid, 4 or more times as long as wide, the hyaline points narrower at base and not extending down the margins of the lamina as in *G. laevigata*.

19. GRIMMIA LAEVIGATA (Brid.) Brid. *Bryol. Univ.* 1: 183. 1826.

*Campylopus laevigatus* Brid. *Mant.* 76. 1819.

*Grimmia campestris* Burch. in Hook. *Musc. Exot.* 2: 9. 1820.

*Grimmia leucophaea* Grev. *Wern. Trans.* 4: 87. 1822.

*Dryptodon leucophaeus* Brid. l. c. 773.

*Dryptodon campestris* Hook. in Brid. l. c. 774.

*Grimmia albida* Spreng. *Syst. Veg.* 4: 321. 1827.

*Grimmia Oertzeniana* Schultz. in Syll. *Ratisb.* 134. 1828.

*Grimmia leucophaea*, var. *subrotunda* Wils. in *Lond. Journ. Bot.* 449. 1846.

*Grimmia subfusca* Wils., in *Kew Journ. Bot.* 9: 323. 1857.

*Grimmia sarcocalyx* Kindb., in Macoun, *Cat. Can. Pl.* 6: 66. 1892.

Plants in loose, irregular, flat, fragile, gray tufts; stems erect, mostly simple, about 1 cm. high, leafy above, radiculose at base; central strand present; leaves closely appressed when dry, crowded, lower leaves small and muticous; upper leaves gradually larger, *ovate-lanceolate*, concave, 1-1.5 mm. long, bistratose, except at the base, margins plane, not thickened; *hyaline hair point long, usually strongly spinulose, flattened at the base and decurrent*; costa weak, flat; upper leaf cells regular, incrassate, chlorophyllose, roundish-quadrate, 6-9  $\mu$  in diameter, those at the base quadrate, non-sinuose, slightly incrassate, or those near the costa elongated and more or less hyaline; perichaetial leaves larger, with longer hair points. Dioicous; seta erect, straight, yellowish, 1-2 mm. long; capsule erect or nearly so, emergent, ovoid or ellipsoid, reddish-brown, smooth, narrow at the mouth, thick walled; calyptra mitrate, lobed at base; lid shortly beaked; annulus of three rows of cells; stomata obsolete or nearly so; peristome teeth papillose, reddish, irregularly 2-3-cleft and cribose, strongly articulated; spores smooth, yellow, 12-16  $\mu$  in diameter, in spring.

ILLUSTRATIONS.—*Bryol. Eur. pl.* 257; Braithw. *Brit. Moss Fl.* 2, *pl.* 49c; Dixon, *Handb. Brit. Mosses*, (Ed. 3) *pl.* 20c; Roth, *Eur. Laubm.* 1, *pl.* 2, 32; Grout, *M.H.M. fig.* 57; Loeske, *Laubm. Eur.* 1913, *figs.* 16g, h, 18, 19, 20, 23c; Schwaegr. *Suppl.* 4, *pl.* 306.

EXSICCATI.—Baker 285; Small 24, 69, 89, 9129, 9489; Howe 58; Holzinger 24, 411; Bartram 6; Sull. & Lesq. *Musc. Bor. Am.* (Ed. 1) 140.

On dry rocks (chiefly non-calcareous), often on granite, basalt, or sandstone, usually in warm situations, fruiting in spring. New York to British Columbia, southward to Arizona, Oklahoma, and Alabama. Europe, Asia, Africa, New Zealand, Australia. In North America *Grimmia laevigata* is a lowland and southern species, rather than alpine and northern, and is apparently seldom collected in Canada. It is a very distinct species with its broad leaves with conspicuous, broad, spinulose-denticulate, whitish aristae.

20. GRIMMIA COMMUTATA Hueben. *Musc. Germ.* 185. 1833.

*Dicranum durum* Lag. *Ann. d. Cienc. Nat.* 4: 177. 1802.\*

*Grimmia ovata* Web. & Mohr, *Natur. Reise d. Schwed.* 132. 1804.

*Trichostomum ovatum* Web. & Mohr. *Bot. Taschbl.* III, ex. p. 1807.

*Campylopus curvifolius* Brid. *Mant.* 78. 1819.

*Campylopus ovatus* Brid. l. c. 76.

*Grimmia elliptica* Funck, *Moost.* 16. 1820.

*Dryptodon ovatus* Brid., *Bryol. Univ.* 202. 1826.

*Dryptodon curvifolius* Brid. l. c. 201.

*Dryptodon ellipticus* Hartm. *Skand. Fl.* (Ed. 3) 27. 1838.

*Guembelia elliptica* Hampe, *Bot. Zeit.* 124. 1846.

\* The identity of *Dicranum durum* with *G. commutata* seems somewhat uncertain.

*Grimmia ovalis* Lindb. Musc. Scand. 30. 1879.

*Grimmia incana* Wils. Kew Journ. Bot. 9: 323. 1858.

*Guembelia ovalis* C. Muell. Syn. 1: 774. 1849.

Plants in broad, loose, fragile, dark green or slightly gray tufts; stems erect, leafless below, 2-4 cm. long; central strand distinct; leaves lanceolate, loosely imbricated when dry, concave, erect-spreading when moist, 2-2.5 mm. long, 2-3-stratose in the upper half; the lower ones small and muticous; hair point long, stout, somewhat spinulose; margins plane or somewhat weakly incurved and thickened in the upper part of the leaf; *costa* distinct but *not prominent* in the upper part of the leaf; upper cells roundish-quadrate, incrassate, obscure, chlorophyllose, somewhat sinuose, 7-9  $\mu$  in diameter; *those at the base elongate-rectangular*, yellowish, more or less incrassate and sinuose, marginal ones shorter and often pellucid. Dioicous; seta erect, straight, 3-4 mm. long; capsule erect or nearly so, ovoid or broadly ellipsoid, dark reddish brown, contracted below the mouth, smooth, 1.5-2 mm. long; *calyptra* large, *cucullate*; lid with a slender, oblique beak; annulus of three or four rows of cells; stomata in one row; peristome teeth erect when dry, reddish, papillose, 2-3-cleft to the middle and cribose, strongly articulated; spores smooth, yellowish, 8-10  $\mu$  in diameter, in spring.

Type locality, European.

British Columbia to Arizona; Quebec, Wisconsin, Minnesota. Greenland. Europe. Asia. Africa.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 256; Braith, Brit. Moss Fl. 2, *pl.* 504; Dixon Handb. Brit. Mosses, (Ed. 3) *pl.* 191; Roth, Eur. Laubm. 1, *pl.* 33; Broth., Engler & Prantl, (Ed. 2) 10, *fig.* 256A-E; Loeske, Laubm. Eur. 1913, figs. 16c, d, e, 17B, 25d; *Pl.* 7.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 362; Macoun, Can. Musci 273; Bartram 39; Williams 244; Holzinger 23; MacFadden 450, 777.

#### 21. GRIMMIA OLYMPICA E. G. Britt. Bryologist 13: 59. 1910.

Plants in dull brown or green mats; stems procumbent at base, erect-ascending at apex, 5-8 mm. high; leaves erect-spreading or slightly secund, 1-2 mm. long, all except the uppermost muticous, acuminate and canaliculate at apex; margins incurved in the upper half of the leaf; basal cells rectangular, pellucid; upper cells roundish-quadrate, thickened, opaque; perichaetial leaves longer, with very short hyaline tips. Dioicous (?); seta erect, flexuose, 1-2 mm. long; capsule ovoid, slightly exserted, 0.5-1 mm. long, ribbed when dry; calyptra mitrate (?); lid with a short, straight beak; annulus large, deciduous with the lid; *peristome none*; spores smooth, yellowish, 8-10  $\mu$  in diameter, maturing in August.

Type locality, on soil over rocks, Queets River valley near Humes Glacier, altitude 5,500 feet, Olympic Mountains, Washington, collected on August 14, 1907, T. C. Frye 614.

This species is said by its author to differ from *Grimmia gymnostoma* Cul. Rev. Bryol. 23: 108. 1896 in the nearly muticous leaves and the somewhat arcuate seta. It is known only from the type locality.

ILLUSTRATIONS.—Bryologist 13, *pl.* 7; *Pl.* 9.

#### 22. GRIMMIA BREVIROSTRIS Williams, Bryologist 23: 52. 1920.

Plants in compact, brownish tufts; stems 1-2 cm. high, irregularly branched, sparingly radiculose below; leaves erect-spreading when moist, somewhat flexuose when dry, oblong-lanceolate, about 2.5 mm. long, gradually narrowed to a somewhat, obtuse *muticous* apex, bistratose in upper half; *costa* strong at base of leaf, indistinct or obsolete above; upper cells roundish-quadrate, opaque, 6-8  $\mu$  in diameter, those at the base quadrate or rectangular, somewhat incrassate, smooth or slightly sinuose; perichaetial leaves about 3.5 mm. long. Dioicous; seta erect, straight or nearly so, twisted when dry, 2.5 mm. long; capsule erect ellipsoid, smooth 1-1.5 mm. long; *stomata none*; *annulus none*; peristome teeth reddish or brownish, irregularly cleft and cribose, faintly papillose; lid with a short, oblique beak; *calyptra cucullate*; *spores* nearly smooth, *about 8  $\mu$  in diameter*.

Type locality, mountains near Buck's Valley, Plumas County, California, at 5,600 feet altitude, on granite. Collected by John B. Leiber 5445, July, 1900.

ILLUSTRATIONS.—Bryologist, l. c. *pl.* 3; *Pl.* 7.

EXSICCATI.—Known only from the type collection.

#### 23. GRIMMIA UNICOLOR Hook.; Grev. Scot. Crypt. Fl. 3: *pl.* 123. 1825.

*Grimmia atrata* Spreng. Car. Linn. Syst. Veg. 4: 154. 1827. Not Mielich. 1819.

*Grimmia norvegica* Bryhn, Kgl. Norske Vids. Selsk. Skrift. 3: 26. 1889.

Plants in loose, flat, dark green tufts; stems slender, ascending, 1.5–4 cm. long, branched, blackish, leafless and scarcely radiculose at base, round in cross section; central strand present; leaves imbricated or somewhat curved when dry, erect-spreading when moist, mucous, the upper ones about 2 mm. long, oblong or ligulate, or ovate-lanceolate, obtuse, almost cucullate at apex, concave, 2–4-stratose in the upper half; costa flattened and somewhat indistinct in upper half of leaf; basal cells yellowish, smooth-walled, those near the costa rectangular or quadrate, those near the margins often elongated and pellucid; upper cells roundish-quadrate, not sinuose, incrassate, obscure, opaque, 7–9  $\mu$  in diameter; perichaetial leaves unistratose. Dioicous; seta straight, yellowish, 3–4 mm. long; capsule erect or nearly so, exserted, ovoid or ellipsoid, smooth, brownish, and slightly contracted below the mouth when dry, 1.3–1.5 mm. long; *calyptra* usually *mitrate*, seldom sub-cucullate; lid long beaked; *annulus* of 4–5 rows of cells, separating in fragments; stomata in one row; peristome teeth narrow, densely articulated, finely granular, irregularly cleft to the middle; *spores* yellowish, smooth, 10–15  $\mu$  in diameter, in summer.

Type locality, Clova, Angusshire, [Forfarshire] Scotland, discovered by T. Drummond.

On moist, non-calcareous rocks in Quebec and Ontario to New Hampshire and Vermont; Minnesota; British Columbia; California. Europe, Asia.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 260; Braithw. Brit. Moss Fl. *pl.* 50E; Dixon, Handb. Brit. Mosses, (Ed. 3) *pl.* 20 G; Roth, Eur. Laubm. 1, *pl.* 33; Grout, M.H.M. *fig.* 58; Loeske, Laubm. Eur. 1913, *figs.* 23b, 24, 35c.

EXSICCATI.—Macoun, Can. Musci 95; Collins 4294; Aust. Musc. Appal. Suppl. 501.

#### Subsection 4. ALPESTRES Vilhelm, Var. Grimm. Česk. 17. 1924.

Leaves keeled, 2–4-stratose in the upper half; costa prominently convex on the dorsal side of the leaf; margins often more or less incurved or revolute at least on one side of the leaf (plane in *G. Doniana*); basal leaf cells smooth-walled. Autoicous or dioicous; capsule symmetrical, exserted.

#### 24. GRIMMIA DONIANA Sm. Brit. Fl. 3: 1198. 1804.

*Grimmia obtusa* Schwaegr. Suppl. 1: 88. 1811.

*Grimmia bohemica* Schkuhr. in Brid. Bryol. Univ. 1: 176. 1826.

*Grimmia Donniana*, var. *curviseta* Lesq. & James, Man. Mosses N. Am. 143. 1884.

*Grimmia Doniana*, var. *eu-Doniana* Loeske, Laubm. Eur. 1: 91. 1913.

Plants in small, low, dense, roundish, dark grayish green, hoary tufts 3–6 cm. in diameter; stems erect, 1–2 cm. high, with rhizoids at the base; central strand present; leaves imbricated and slightly curved when dry, erect-spreading when moist, the lower ones small and mucous, the upper leaves elongate-lanceolate, 2–3 mm. long, strongly keeled, bistratose in the upper half; hair point variable in length, slender, weakly spinulose; margins plane, slightly thickened above; upper cells sinuose, chlorophyllose, incrassate, roundish-quadrate, 8–9  $\mu$  in diameter, those at the base narrowly rectangular, smooth walled, those near the margins somewhat hyaline; perichaetial leaves larger, usually with longer hair points. Autoicous; seta 1.5–2.5 cm. long, erect or nearly so, straight; capsule emergent, erect, ellipsoid-ovoid, smooth, brownish, 1–1.5 mm. long; calyptra small, mitrate, or occasionally cucullate, 2–5-lobed at base; lid conical, obtuse; annulus fragile, of 2–3 rows of small cells, or sometimes rudimentary; stomata small, at the base of the capsule; peristome teeth red, papillose, cribose or entire, articulate; spores yellowish brown, smooth, 7–9  $\mu$  in diameter, in autumn.

Type locality, "on large stones near a water-fall on a mountain in Angusshire, 18 miles to the north of Forfar" (Scotland). Collected by George Don.

On various rocks, mostly in mountainous regions in western North America. Alberta to New Mexico; Quebec, Vermont; Greenland; Europe. Asia.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 249; Limpr. Laubm. Eur. 1, *fig.* 198; Braithw. Brit. Moss Fl. 2, *pl.* 49D; Dixon, Handb. Brit. Mosses, (Ed. 3), *pl.* 19F; Roth, Eur. Laubm. 1, *pl.* 32; Grout, M.H.M. *fig.* 56; Loeske, Laubm. Eur. 1913, *figs.* 1d, 26a, 28, 31a, c; Sm. Eng. Bot. *pl.* 1259.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 363; Pickett 218; Collins 4378; Flowers 506; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 142; Aust. Musc. Appal. Suppl. 500.

#### 25. GRIMMIA TERETINERVIS Limpr. in 61 Jahresb. d. Schles. Ges. 216. 1884.

*Schistidium* (?) *teretinerve* Limpr. Laubm. 1: 717. 1889.

*Grimmia tenuis* Barker, Roth, Eur. Laubm. 2: 691. 1905.

Plants blackish or dark green, in fragile, roundish tufts; stems simple, 1–2 cm. long; central strand poorly developed; *leaves linear-lanceolate*, erect-spreading when moist, concave, 1.2–1.4 mm. long, the lower ones muticous or nearly so and unistratose, the upper ones with a short, spinulose hair point, or muticous; *margins and apex conspicuously thickened*, plane, bistratose, sometimes slightly revolute near the base; costa stout, terete; leaf cells not sinuose, mostly roundish-quadrate, 6–8  $\mu$  in diameter, a few rows at the base near the costa shortly rectangular. Dioicous; only sterile archegonial plants known.

Type locality, "An trockenen, sonnigen Kalkfelsen im 'Kalchstein' 1800 m. bei Innervillgraten in Tirol vom Pfarrer Hieronymus Gander am 27. Juli 1882 entdeckt."

ILLUSTRATIONS.—Roth, Eur. Laubm. 1, pl. 30; Loeske, Laubm. Eur. 1913, figs. 9a, 14; Bryologist 3: 21, figs. 1–13; Pl. 8.

EXSICCATI.—Winona, Minnesota, J. M. Holzinger, June 1, 1894, and in 1903; Sugarloaf, Minnesota, J. M. Holzinger, October 19, 1900; Knoxville, Tennessee, A. J. Sharp, August 1, 1930.

Idaho, Minnesota, Ontario, Tennessee. The dioicous inflorescence and the plane-margined leaves indicate an affinity with the subsection Litoneurum.

#### 26. GRIMMIA TENUICULIS Williams, Bull. Torr. Club. 27: 316. 1900.

Plants in compact green tufts; stems slender, 2–7 cm. long, often filiform, simple or with a few short branches; leaves numerous, crowded, unistratose, imbricated when dry, nearly uniformly distributed along the stem, all but the very lowest with short hyaline hair points, erect-spreading when moist; median and upper leaves lanceolate or ovate-lanceolate, 0.75–1.25 mm. long with the hyaline point up to 0.5 mm. long; margins unistratose, plane above, sometimes recurved near base of leaf; costa stout, terete, prominent; hair point spinulose, the spinules spreading or sometimes recurved; upper and median cells irregular, dense, opaque, isodiametrical or nearly so, 4–6  $\mu$  in diameter; basal cells larger, roundish or quadrate; perichaetial leaves larger, broadly ovate-lanceolate; evidently dioicous; sporophyte unknown.

Type locality, near Neihart, Belt Mountains, Montana. Discovered by R. S. Williams, September 21, 1891.

ILLUSTRATIONS.—Bull. Torr. Club 27, pl. 20; Pl. 17.

EXSICCATI.—Rocks, Tunkwa Lake, Nicola District, British Columbia, May 30, 1910, A. Brinkman (Holz. Musc. Acro. Bor.-Am. 406); on granite rocks, Dale Creek, Albany Co., Wyoming, C. L. Porter 979.

This moss has a distinctive appearance on account of the long, slender stems. The stout terete costa is suggestive of *G. teretineris*. The true relationship of this species cannot be determined until fruiting plants are discovered. Specimens of this species have been collected, also by Williams, at Marsh Lake and Dawson on the Yukon River, Yukon, Canada. The known range of the species at the present time is Yukon, British Columbia, Alberta, Montana, and Wyoming.

#### 27. GRIMMIA COLORADENSIS Aust. Bot. Gaz. 2: 109. 1877.

Plants tufted; stems fastigiate branched, 2–10 mm. long; leaves erect-spreading when moist, lanceolate or lingulate, strongly carinate, 0.75–1 mm. long, acute, non-plicate, muticous, or the upper ones shortly hyaline-apiculate; margins more or less thickened; costa strong, subpercurrent; upper and median leaf cells dense, roundish, 4–6  $\mu$  in diameter, becoming larger toward the base of the leaf; basal cells quadrate or shortly rectangular, the walls somewhat thickened and yellowish green, those cells toward the margin of the leaf with the cross walls somewhat thicker than the long walls; perichaetial leaves erect, larger, spinulose hyaline at the apex. Autoicous; seta short, straight; capsule "globose," macrostomous; calyptra mitrate, 0.5 mm. long; lid unknown; peristome teeth short and broad, reddish, sparingly papillose, subcristate at apex, spreading when dry, incurved when moist; spores smooth, yellowish, 6–9  $\mu$  in diameter.

Type locality, Colorado. Collected by Brandegee in 1876, and not otherwise known.

ILLUSTRATIONS.—Pl. 25.

EXSICCATI.—Colorado, without definite locality, Brandegee, in 1876.

According to Austin, this is one of the smallest species in the genus, to be "readily distinguished by the carinate mutic or very shortly pointed leaves somewhat thickened and often slightly recurved on the margin above the middle, with the costa ceasing far below the apex, and by the short straight pedicel." According to Lesquereux & James (Man. Mosses N. Am. 143. 1884) "The absence of the lid and calyptra renders the relations of this moss uncertain. The characters of the leaves and areolation, the form of the capsule, and the peristome are those of *G. Donniana*, var. *elongata*, whose leaves are muticous or shortly hyaline-apiculate; but the pedicel is long."

Through the courtesy of Mr. R. S. Williams of the New York Botanical Garden, it has been possible to

reexamine a portion of the type collected by T. S. Brandegee in 1876. The material is in a very fragmentary condition and consists of a few small, sterile plants with some pieces of a peristome with a few spores adhering, and one *mitrate* calyptra. An examination of the peristome teeth and the leaves substantiates Austin's description of them. Except for the discovery of the calyptra and spores, there is nothing to add to the description of this moss until further collections are made. The above description is drawn up partly from the original and partly from the single collection examined. *G. coloradensis* is apparently distinct from any other published species, but the available material is not sufficiently complete to indicate its real relationship. However, it is probable that it should be placed in the subsection *Alpestris*.

28. GRIMMIA MONTANA Bryol. Eur. 3: (fasc. 25-28) 26. 1845.

*Guembelia montana* Hampe, Bot. Zeit. 124. 1846.

*Grimmia montana*, var. *brachyodon* Aust. Bull. Torr. Club 6: 45. 1879.

*Grimmia montana*, var. *truncata* Lesq. & James, Man. Mosses N. Am. 145. 1884.

*Grimmia Jamesii* Aust. l. c. 43.

*Grimmia lenella* C. Muell. Bot. Centralbl. 44: 388. 1890.

*Grimmia pseudo-montana* Card. & Thér. Bot. Gaz. 30: 18. 1900.

Plants in dense, round, dark green, hoary, non-fragile tufts; stems erect, 0.5-2 cm. high, with rhizoids at base; central strand poorly developed; leaves imbricated when dry, strongly keeled in the upper half, erect-spreading when moist; lower leaves small and muticous; upper leaves much larger, *narrowly lanceolate* from an ovate base, 1.5-2 mm. long; hair point more or less spinulose, about  $\frac{1}{4}$  the length of the leaf or about as long as the leaf in the upper leaves; costa strong, prominently convex on the dorsal side of the leaf; margins plane in the basal portion of the leaf, erect or incurved above the middle; cells incrassate, not sinuose, the upper ones obscure, dense, opaque, chlorophyllose, roundish-quadrate, 7-9  $\mu$  in diameter; basal cells shortly rectangular or quadrate with 4-6 rows near the margin of the leaf quadrate and hyaline and with thickened cross walls; perichaetial leaves larger, with longer hair points. Dioicous; seta erect, straight, yellowish, about 2 mm. long; capsule erect, *ovoid-ellipsoid*, smooth when moist, slightly wrinkled when dry, reddish brown, 1-1.3 mm. long; calyptra cucullate; lid more or less obliquely beaked, the beak  $\frac{1}{8}$ - $\frac{1}{2}$  the length of the capsule; stomata none; peristome teeth yellowish, papillose, irregularly cleft, sometimes reflexed when dry; spores smooth, yellowish, 10-14  $\mu$  in diameter, in spring.

Type locality, Donnersberge, Rheinpfalz. (Germany). Discovered by Philipp Bruch.

ILLUSTRATIONS.—Bryol. Eur. pl. 250; Broth., Musc. Fenn. fig. 32H-I; Braithw. Brit. Moss Fl. 2, pl. 49F; Dixon, Handb. Brit. Mosses, (Ed. 3) pl. 20A; Roth, Eur. Laubm. 1: pl. 33; Loeske, Laubm. Eur. 1913, figs. 1k, 25b, 27l, 31d; Pl. 9.

EXSICCATI.—Macoun, Can. Musci 509; Howe 30; Leiberg 110; Holz. Musci Acro. Bor.-Am. 365, 340; Pickett 227, 218; Eastwood 176; Grant 8111; Mead 990; Piper 301, 203.

On siliceous and calcareous rocks, usually occurring at lower elevations than *G. alpestris*. British Columbia to Arizona, Montana and Wyoming; Greenland. Europe. This species is especially abundant on basaltic outcrops in northwestern United States, where it is one of the first plants to appear in a new association, and is often antecedent to the various foliose lichens. In that region it is frequently associated with *Tortula ruralis*, *Polytrichum piliferum*, and *Camptothecium aeneum*. The combination of characters of quadrate or shortly rectangular basal leaf cells which have the cross walls thicker than the long walls, the cucullate calyptra, and the dioicous inflorescence, will serve to separate this species from all other *Grimmias* except *G. alpestris*. It differs from the latter by the leaves being longer, narrower, more opaque at apex, and by the shorter, ovoid-ellipsoid capsule with the lid obliquely beaked.

29. GRIMMIA ALPESTRIS Nees, Bryol. Germ. 2: 139. 1827.

*Trichostomum pulvinatum*  $\beta$  *alpestris* Web. & Mohr, Bot. Taschb. 110. 1807.

*Dryptodon pulvinatus*  $\gamma$  *alpestris* Brid. Bryol. Univ. 1: 198. 1826.

*Guembelia alpestris* Hampe, Bot. Zeit. 124. 1846.

*Grimmia tenerrima* Ren. & Card. Bot. Gaz. 15: 40. 1890 (February).

*Grimmia nivalis* Kindb. Bull. Torr. Club. 17: 271. 1890 (November).

*Grimmia microtricha* C. M. & Kindb. Mac. Cat. Can. Pl. 6: 70. 1892.

Plants in small, somewhat fragile, thick, dark green or glaucescent tufts 4-8 cm. in diameter, grayish when dry; stems dichotomously branched 0.5-1.5 cm. high, erect, with rhizoids; central strand poorly developed; leaves closely imbricated when dry, erect-spreading when moist, lower ones small, muticous, the upper much larger, lanceolate, bistratose in the upper half, 1-1.5 mm. long, usually free from folds or plica-

tions; hair point almost smooth, or sparingly spinulose; margins incurved and strongly thickened above the middle of the leaf; costa strong, prominently convex on the dorsal surface of the leaf, sometimes more or less channelled on the upper side; upper cells incrassate, not sinuose, opaque, roundish-quadrate, 10–12  $\mu$  in diameter, those near the base quadrate or shortly rectangular, with 2–4 rows near the margin of the leaf quadrate and hyaline with the cross walls thicker than the long walls; perichaetial leaves larger. Dioicous; seta 1.5–3 mm. long, erect, straight; capsule erect, 1–1.5 mm. long, cylindrical, narrowed at base, yellowish brown, smooth or somewhat sulcate in age; calyptra cucullate; lid conical or with a short straight obtuse beak; annulus not differentiated; stomata none or few and small, functionless; peristome teeth reddish, finely papillose, irregularly cleft to the middle and cribose; spores smooth, yellowish, 8–12  $\mu$  in diameter, spring to summer.

Type locality, St. Bernard, Switzerland. Discovered by Johann Schleicher.

ILLUSTRATIONS.—Bryol. Eur. pl. 251; Limpr. Laubm. Eur. 1, fig. 204; Braithw. Brit. Moss Fl. 2, pl. 49E; Dixon, Handb. Brit. Mosses, (Ed. 3) pl. 20B; Roth, Eur. Laubm. 1, pl. 33; Loeske, Laubm. Eur. 1913, figs. 25b, 27a, b, c; Pl. 10.

EXSICCATI.—Macoun, Can. Musci 267, 414; Collins 3961; Baker 944; Brewer 2802; Copeland 1158; Leiberg 40; Abrams 2921; Flowers 2057, 1088, 2081, 1072, 1114, 810, 1086.

On siliceous rocks in mountainous regions. British Columbia and Alberta to California, Nevada, and Utah; Gaspé Co., Quebec; Greenland. Europe. Asia. This species is closely allied to *G. montana*, from which it may be distinguished by the shorter and broader leaves, the cylindrical capsule with the lid shorter, and obtusely straight beaked, and the darker red peristome teeth. *G. tenerrima* Ren. & Card., and *G. nivalis* Kindb., appear to be merely small forms of *G. alpestris*.

29a. Var. *MICROSTOMA* Bryol. Eur. fasc. 25–28. 1845.

*Grimmia lamellosa* C. Muell. Bot. Zeit. 318. 1854.

*Grimmia alpestris typica* Chalub. Grimm. Tatrens. 68. 1882.

*Grimmia subsulcata* Limpr. Laubm. Eur. 1: 757. 1889.

*Grimmia sessitana*, var. *subsulcata* Breidl. Laubm. Steierm. 88. 1891.

*Grimmia alpestris*, var. *stomata*, f. *subsulcata* Loeske, Laubm. Eur. 1: 105. 1913.

*Grimmia alpestris*, var. *subsulcata* Broth. E.-P. (Ed. 2) 10: 309. 1924.

*Grimmia sessitana*, f. *subsulcata* Loeske, Mon. Eur. Grimm. 117. 1930.

Plants in thick, dark green tufts 1–1.5 cm. high; leaves lanceolate, acuminate, bistratose above the middle, with a smooth hyaline hair point, and a distinct longitudinal plication on each side of the costa; margins 2–3 stratosed, incurved in the upper half of the leaf, which is often more or less cucullate at apex. Autoicous, though apparently dioicous, the antheridial and archegonial buds terminal on separate branchlets; peristome teeth cleft to the middle and cribose; spores yellowish, smooth, 10–12  $\mu$  in diameter.

Type locality, Switzerland.

Paris\* reports this plant from Idaho and Montana.

ILLUSTRATIONS.—Loeske, Laubm. Eur. 1, figs. 17c, 23d, 27i, k, 32A; Roth, Eur. Laubm. 1, pl. 33.

29b. Var. *caespiticia* (Brid.) n. comb.

*Dryptodon caespiticius* Brid. Bryol. Univ. 1: 200. 1826.

*Grimmia alpestris*, var. *mutica* DeNot. Syll. No. 325. 1838.

*Grimmia sulcata* Sauter, Flora 1: 39. 1841.

*Guembelia caespiticia* C. Muell. Syn. 1: 773. 1849.

*Grimmia caespiticia* Jur. Laubmfl. 172. 1882.

Plants in thick, dark green tufts 1–1.5 cm. high; leaves shortly lanceolate from an ovate base, bistratose above the middle, muticous or with very short hyaline points, and with a longitudinal plication on each side of the costa; margins 3–4 stratosed, incurved in the upper half of the leaf, which is more or less cucullate at apex. Dioicous; peristome teeth usually entire, seldom cleft or cribose; spores yellowish, granulose, 9–11  $\mu$  in diameter.

Type locality, St. Bernard, Switzerland. Discovered by Bridel.

ILLUSTRATIONS.—Bryol. Eur. pl. 252; Roth, Eur. Laubm. 1, pl. 33; Limpr. Laubm. Eur. 1, fig. 203; Loeske, Laubm. Eur. 1, figs. 27f, g, h, 32b.

\* Paris, E. G. Index Bryologicus, (Ed. 2) 2: 289. 1904.

According to Paris,\* this plant has been collected in Greenland. There is no further record of its occurrence in the western hemisphere, though it may be expected in the Rocky Mountains. The above description is based on European material.

29c. Var. *Manniae* (C. Muell.) n. comb.

*Grimmia Manniae* C. Muell. Flora, 70: 223. 1887.

*Grimmia velutina* Kindb. Rev. Bryol. 18. 1896.

Plants in dense, green tufts; stems slender, leafy, branched; leaves somewhat succulent, imbricated, keeled, obtusely short-acuminate, ovate, with erect margins; upper cells dense, minute, opaque, *basal cells* quadrate, loose, *hyaline, thin walled*, perichaetial leaves larger, obtuse, with larger cells. Dioicous; seta slender, reddish, somewhat spirally twisted; capsule exserted, erect, globose or urceolate, reddish; lid conical, slightly oblique; peristome teeth short, reddish, cribose and somewhat cleft.

Type locality, Napa Springs, Napa County, California. Collected by Mrs. Martha Mann, May 2, 1886, and at Lytton, British Columbia by John Macoun in 1889.

ILLUSTRATIONS.—Bryologist 4: 24, fig. 1b; Pl. 9.

29d. Var. *Holzingeri* (Card. and Thér.) n. comb.

*Grimmia Holzingeri* Card. & Thér. Bot. Gaz. 30: 124. 1900.

Plants in small, dull green cushions; stems slender, erect, sparingly branched, 4–8 mm. high; leaves erect when moist, and not recurved, appressed when dry, crowded, 0.5–1 mm. long, bistratose above the middle, unistratose below, muticous, or the uppermost with very short hyaline points, ovate-lanceolate, concave, with plane margins; costa percurrent, 25–35  $\mu$  wide at base; cells incrassate, the upper roundish-quadrate, those at the base quadrate or rectangular, *thick walled, yellowish green*. Dioicous; seta slender, 2–2.5 mm. long, somewhat spirally twisted; capsule exserted, erect, ovoid or ellipsoid, 1 mm. long; lid, calyptra, and peristome unknown.

Type locality, base of Sperry Glacier, Mt. Trilby, Montana, collected by Holzinger. "Occurs on Archaean rocks, in the heart of the Rockies, at an altitude of 7000–8000 feet, in sight of slowly expiring glaciers. . . ."

*Piper* 236 is identical with *G. Holzingeri* Card. & Thér. It is the only fruiting specimen known.

ILLUSTRATIONS.—Bryologist 4: 24, fig. 1a; Pl. 9.

EXSICCATI.—"On the way from Holzinger's Basin to the "Rim," between Mt. Edwards and Mt. Shepard, July 25, 1898, altitude 6000–7000 ft.," collected by J. M. Holzinger and J. B. Blake (type); Mount Rainier, 6,500 feet altitude, August, 1895, *Piper* 236.

#### Subsection 5. ALPINAE Vilhelm, Var. Grimm. Česk. 39. 1924.

Subgen. *Guembelia*, sectio *b* *Ovales* Hagen ex p. Kong. Norske Vidensk. Selsk. Skrift. 1909, No. 5: 24. 1909.

Subgen. *Ovalae* Loeske, Laubm. Eur. 1: 111. 1913.

Leaves keeled, 2–4-stratose in the upper half, or unistratose except on the margins; costa prominently convex on the dorsal side of the leaf; margins more or less incurved or revolute, at least on one side of the leaf; basal cells often yellowish, and at least those near the costa rectangular or linear with sinuate and incrassate walls, the cross walls not conspicuously thicker than the long walls. Autoicous or dioicous; capsule symmetrical, immersed or exserted; calyptra mitrate.

#### 30. GRIMMIA BRITTONIAE Williams, Bull. Torr. Club 27: 316. 1900.

Plants in dense, grayish, hemispherical tufts; stems slender, 1.5–3.5 cm. long, usually with long branches; upper and median leaves oblong-lanceolate, 1 mm. long, acute, unistratose; margins plane, one or both of them sometimes bistratose; *hyaline points very long*, nearly smooth, *2–4 times the length of the laminae, or 8–10 times the length of the perichaetial leaves*; upper and median cells somewhat irregular, roundish-quadrate, 6–8  $\mu$  in diameter; basal cells rectangular, shorter toward the margins, all more or less sinuose and incrassate. Dioicous; sporophyte unknown.

\* Paris, E. G. Index Bryologicus (Ed. 2) 2: 268. 1904.

Type locality, Bad Rock Canyon, Flathead River, Montana, collected by R. S. Williams "on shaded perpendicular walls, partly calcareous, in rather dry places," and not otherwise known.

ILLUSTRATIONS.—Bull. Torr. Club 27, *pl. 19; Pl. 12.*

EXSICCATI.—On rocks, Columbia Falls, Montana, R. S. Williams, May 22, 1897 (Holz. 283).

This species, whose phylogenetic position is at present uncertain, is remarkable for the extreme length of the hyaline points of the leaves. The histological structure of the leaves resembles no other species of the genus very closely. This species was dedicated by its author to the eminent American bryologist, Mrs. Elizabeth Gertrude Britton.

31. GRIMMIA ELONGATA Kaulf. in Sturm, Deutschl. Fl. 2: Heft 15 c. icon. 1815.

*Grimmia orientalis* Wils. Kew. Journ. Bot. 9: 323. 1857.

Plants in dense, tall, brownish or blackish green, fragile tufts; stems erect, slender, brittle, often leafless or nearly so at base, branched, 2–5 cm. high, decumbent and radiculose at base; central strand present, small; leaves small, stiff, imbricated and slightly twisted when dry, crowded, erect-ascending when moist, narrowly linear-lanceolate, 1–1.8 mm. long, carinate-concave, with a short, hyaline spinulose hair point, or some of the leaves with only a few of the apical cells hyaline; or the lower leaves muticous; costa distinctly narrowed at base; margins recurved on one side only, thickened above; cells yellowish, incrassate, upper ones strongly sinuose, roundish-quadrate, 8–9  $\mu$  in diameter; median basal cells smooth-walled, elongate-rectangular or linear. Dioicous; seta 2–3 cm. long, straight, yellowish; capsule exserted, erect, ellipsoid, 1–2 mm. long, brownish, smooth, not contracted below the mouth when dry; calyptra cucullate-mitrate, 2–5 lobed at the base; lid conical, obtuse; annulus fragile, of 1–3 small reddish cells; stomata large, in one row; peristome teeth papillose, entire or slightly cribose; spores yellow, finely granulose, 12–16  $\mu$  in diameter, in late summer.

Type locality, Steiermark, Austria. Collected by Kaulfuss in 1812.

*Grimmia elongata* is not yet known to occur on continental North America, but it has been reported from Greenland.\*† The above description has been drawn from European specimens.

ILLUSTRATIONS.—Bryol. Eur. *Pl. 259*; Braithw. Brit. Moss Fl. 2, *pl. 47 C*; Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 20 E*; Roth, Eur. Laubm. 1, *pl. 33*; Loeske, Laubm. Eur. 1913, *figs. 17g, 23e, 25a; Pl. 8.*

32. GRIMMIA PILIFERA Beauv. Prodr. 52. 1805.

*Grimmia apocarpa*  $\beta$  *pilifera* Brid. Sp. Musc. 1: 97. 1806.

*Grimmia pensylvanica* Schwaegr. Suppl. 1: 91. 1811.

*G. pensylvanica*, var. *Bestii* Grout, Bryologist 7: 6. 1904.

Plants in dense, coarse, robust, dark green, spreading tufts; stems rigid, branched, 1–3 cm. high; leaves loosely imbricated when dry, erect-spreading when moist, lower leaves smaller, muticous, upper leaves lanceolate, or narrowly ovate-lanceolate, bistratose in the upper half, more or less canaliculate, acuminate, concave, sometimes propaguliferous; upper ones with short, spinulose hair points; costa strong, percurrent; margins strongly recurved in the lower half of the leaf, thickened in the upper half; median and upper leaf cells, dense, opaque, chlorophyllose, incrassate, sinuose, roundish or hexagonal, 6–9  $\mu$  in diameter; cells at the extreme base of the leaf elongate-rectangular, thin walled, somewhat hyaline, above these the cells are quadrate, incrassate and sinuose; perichaetial leaves longer, with longer hair points. Dioicous; seta erect, straight, about half the length of the capsule; capsule erect, immersed, ellipsoid, smooth; calyptra mitrate, lobed at base; lid straight beaked; annulus large; peristome teeth irregularly cleft and cribose to the middle; spores autumn to winter.

Type locality, Pennsylvania. Discovered by Muehlenberg.

Common on dry rocks, Nova Scotia to Minnesota, south to Arkansas and Georgia; Mexico; Japan.

ILLUSTRATIONS.—Sull. Icones *pl. 43*; Grout, M. H. M. *pl. 20*; Schwaegr. Suppl. 1, *pl. 25.*

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 25; Best, N. Am. Mosses, March 20, 1890; Macoun, Can. Musci 264; Bartram 1503, 847, 129, 477, 217, 255, 103; Schallert 1199, 1966; Small 75; Drumm. Musc. Am. 56; Sull. Musc. Allegh. 137; Sull. & Lesq. Musc. Bor. Am. (Ed. 1); 138, (Ed. 2), 210; Aust. Musc. Appal. 143; R. & C. Musc. Am. Sept. 170.

\* Macoun, John, Catalogue of Canadian Plants 6: 71. 1892.

† Paris, E. G., Index Bryologicus, (Ed. 2) 2: 273. 1904.

## 33. GRIMMIA ARIZONAE Ren. &amp; Card. Rev. Bryol. 19: 85. 1892.

*Grimmia santa-ritae* Bartr. Bryologist 27: 60. 1924.

Plants in loose tufts, olive green or yellowish green; stems robust, decumbent, leafless toward the base, branched above, 2-3 cm. long; *leaves plane*, lanceolate, acuminate, bistratose in the upper part, 2-4 mm. long; *hair point* fairly long, stout, *strongly spinulose*; margins *not thicker than the rest of the leaf*, plane, or one narrowly recurved below the middle of the leaf; upper and median leaf-cells roundish-quadrate, somewhat obscure, irregular, sinuose and incrassate, 7-8  $\mu$  in diameter; basal cells toward the costa linear or rectangular, sinuose, incrassate, becoming shorter and broader toward the leaf-margins. Dioicous; seta shorter than the capsule, less than 1 mm. long, erect, straight; *capsule immersed*, ovoid or ellipsoid, 1.3-1.6 mm. long, smooth, pale brownish; annulus distinct, of 2-3 rows of cells; lid with a short, straight beak; calyptra mitrate, irregularly lobed at the base, reaching somewhat below the base of the lid; peristome teeth reddish, irregularly 2-3-cleft above the middle into papillose divisions; spores ovoid, more or less granular, 9-12  $\mu$  in diameter, in winter.

Type locality, Fort Grand (Grant), Arizona.

ILLUSTRATIONS.—Bryologist, 27, Pl. 9; Pl. 24.

EXSICCATI.—Orcutt 7149, 7157; Wootton 1501; Holz. Musci Acro. Bor.-Am. 566; Bartram 75, 90, 149, 1346, 1254, 1437, 1642, 1704, and twenty others.

On rocks, Arizona, New Mexico, Oklahoma, Texas. An examination of a fragment of the type of *G. arizonae* from Mr. Bartram's herbarium shows that this species is closely related to *G. pilifera*. The statement by Renaud & Cardot that their species differs from *G. trichophylla*, although true, is somewhat misleading, since *G. arizonae* belongs to the section Orthogrimmia instead of to Rhabdogrimmia.

A form with numerous clusters of spherical multicellular gemmae on the surfaces of the leaves may be known as forma *propagulifera* (Bartr.) n. comb. Anent the distribution of *G. arizonae* Mr. Bartram states, "The species is a very abundant one in the Mountains of southern Arizona, extending eastward through southern New Mexico to the mountains of western Texas and La Foret's collection from Fort Grand (Grant?), Arizona, which is on the southwestern slopes of the Pinaleno Mts., in southern Graham Co., would therefore fall well into the range as at present known."\*

## 34. GRIMMIA OVALIS (Hedw.) Lindb. Acta Soc. Sc. Fenn. 10: 75. 1871.

*Dicranum ovale* Hedw. Musc. Frond. 3: 81. 1792; Sp. Musc. 140. 1801.

*Trichostomum ovatum* Web. & Mohr, Bot. Taschb. 111, ex p. 1807.

*Grimmia patens* Hornsch. Flora 1: 84. 1819.

*Grimmia neilgherriensis* C. Muell. Bot. Zeit. 62. 1853.

*Grimmia lurida* Wils. Kew Journ. Bot. 9: 44. 1857.

*Grimmia ovata*, var. *euovata* Loeske, Laubm. Eur. 1: 113. 1913.

*Grimmia catalinensis* Bartr., Bryologist 27: 62. 1924.

Plants in small, dense, roundish, olive green to grayish or blackish tufts; stems erect, branched, 1.5-2.5 cm. high, with rhizoids at base; central strand present; upper leaves 2.5-3 mm. long, imbricated when dry, erect-spreading when moist, lanceolate, bistratose above; *hyaline points almost smooth, about 1/3 the length of the lamina*; one margin slightly recurved, the other plane, thickened above; upper and median cells incrassate, sinuose, roundish-quadrate, 7-8  $\mu$  in diameter, those at the base yellowish green, elongate-rectangular or some near the costa linear, somewhat incrassate and more or less sinuose, a few near the margins thinner walled, roundish-quadrate and pale green or pellucid; perichaetial leaves larger with laxer cells and longer hair points. Autoicous; seta erect, 2-3 mm. long, yellowish, straight; *capsule erect, exerted, ovoid or ellipsoid, 1-1.3 mm. long*, brown, smooth or longitudinally striate in age; calyptra mitrate, lobed at base, or occasionally subcucullate; lid small, red, conical, with a straight or oblique beak; annulus of 3-4 rows of cells, fragile; stomata in one row; peristome teeth erect when dry, reddish, densely papillose, 2-3-cleft to the middle; spores smooth, yellowish, 9-12  $\mu$  in diameter, in autumn.

Type locality, Saxony. Discovered by Hedwig in 1792.

ILLUSTRATIONS.—Bryol. Eur. pl. 254; Schwaegr. Suppl. 1<sup>1</sup>, pl. 24; Braithw. Brit. Moss Fl. 2: pl. 50 B; Dixon Handb. Brit. Mosses, (Ed. 3) pl. 19 H; Roth, Eur. Laubm. 1, pl. 29, 32; Loeske, Laubm. Eur. 1913, figs. 31f, 33; Bryologist 27, pl. 10; Pl. 11.

EXSICCATI.—Drumm. Musc. Am. 59; Sull & Lesq. Musc. Bor.-Am. (Ed. 2) 213, 214 (var.); Macoun, Can. Musci 270; Knowlton 149; Bartram 809, 829a, 39, 397, 407, 387A, 390B, 372, 1204, 1146, 1255, 1074,

\* Bartram, E. B., Bryologist 32: 11. 1929.

1150, 1227, 1151, 61, 75, 115, 116, 62, 66, 65, and twenty others; Holz. Musci Acro. Bor.-Am. 565; Holzinger 23; Orcutt 7073.

On rocks, Greenland and Labrador to Yukon and British Columbia, southward to New Mexico and New York. Europe. Asia. *C. catalinensis* appears to be identical with *G. ovalis* in all essential respects.

34a. *Forma affinis* (Hornsch.) n. comb.

*Grimmia affinis* Hornsch. Flora 2<sup>1</sup>: 443. 1819.

*Grimmia ovata*, var.  $\beta$  *affinis* Bryol. Eur. 3: (fasc. 25-28) 21. 1845.

This is an alpine or subalpine form with the *leaves long hyaline-pointed*, and the *capsules emergent*, ovoid or ellipsoid, on long setae.

ILLUSTRATIONS.—Bryol. Eur. pl. 255  $\beta$ .

On rocks, Tranquille Creek, Kamloops Lake, altitude 2,200 feet, British Columbia, October 25, 1909, A. Brinkman 139.

34b. *Forma cylindrica* (Nees, Hornsch., & Sturm) n. comb.

*Grimmia cylindrica* Nees, Hornsch., & Sturm, Bryol. Germ. 2<sup>1</sup>: 161. 1827.

Plants in large thick tufts; stems erect, up to 5 cm. long; *leaves broadly lanceolate, with short hair points; capsule exserted, cylindrical, 2 mm. long; beak of the lid longer.*

ILLUSTRATIONS.—Bryol. Eur. pl. 255  $\delta$ ; Loeske, Laubm. Eur. 1913, fig. 33; Bryol. Germ. pl. 23, fig. 18.

On rocks, Pikes Peak, 8,900-9,700 feet altitude, Colorado, S. L. Clarke in 1895.

34c. *Forma mutica* (Bartr.) n. comb.

*Grimmia catalinensis*, var. *mutica* Bartr. Bryologist 27: 62. 1924.

*Leaves all muticous*; plants occurring "either in pure tufts or mixed with the species"; *capsules emergent*.

On low boulders, White House Canyon, Santa Rita Mountains, Santa Cruz County, Arizona, February 18, 1923, E. B. Bartram 683 B (type).

## Section 2. RHABDOGRIMMIA Limpr. Laubm. 1: 759. 1889.

Capsule symmetrical, exserted, shorter than the seta, sulcate or longitudinally ribbed to obscurely striate or almost smooth when dry; seta arcuate or flexuose, *at least when moist*, sometimes curved downward so that the young capsules are hidden among the leaves; sheath narrowly cylindrical; columella often twisted, free from the lid and persistent; calyptra mitrate (except *G. orbicularis*), reaching below the lid, non-plicate; stomata present; leaves keeled, plane, or usually revolute at least on one margin, imbricated, or spirally twisted around the stem when dry and sometimes crisped; costa prominently convex; gemmae sometimes present on the dorsal side of the leaf; species mostly dioicous (except subsection Pulvinatae).

### Subsection 1. PULVINATAE Loeske, Laubm. Eur. 1: 161. 1913.

Autoicous; leaves ovate or oblong, acute or obtuse, abruptly piliferous, imbricated when dry; gemmae absent; stems terete; plants usually fertile; peristome normally developed.

## 35. GRIMMIA PULVINATA (Hedw.) Sm. Eng. Bot. pl. 1728. 1807.

*Bryum pulvinatum* L. Sp. Pl. 1121. 1753.

*Fissidens pulvinatus*  $\alpha$  *communis* Hedw. Sp. Musc. 158. 1801.

*Trichostomum pulvinatum* Sturm. Deutschl. Flora 2: 7. 1805.

*Dicranum pulvinatum* Schwaegr. Sp. Musc. Suppl. 1<sup>1</sup>: 189. 1811.

*Campylopus pulvinatus* Brid. Mant. 175. 1819.

*Dryptodon pulvinatus* Brid. Bryol. Univ. 1: 196. 1826.

Plants in small, compact, hemispherical, grayish green tufts 3-7 cm. broad; stems branched, bearing rhizoids at base, leafy above, 1-1.5 cm. long; central strand present; *leaves elliptical- or oblong-lanceolate, plane, wide at apex, 1-1.5 mm. long, imbricated when dry, erect-spreading when moist, the upper with long, denticulate, more or less flexuose hair points, the lower smaller and muticous or nearly so; margins some-*

what recurved in the lower part of the leaf, plane, *thickened and bistratose toward apex of leaf*, upper cells roundish-quadrate, somewhat sinuose and incrassate, 8–10  $\mu$  in diameter; *basal cells quadrate or shortly rectangular, almost uniform in size, thin-walled*; costa prominently convex on the dorsal side of the leaf. Autoicous; seta reddish, curved when young, erect or ascending in age; capsule horizontal or pendant, ellipsoid, reddish brown, wide-mouthed, and distinctly 8-striate when dry, the young capsules bent down among the leaves; *calyptra mitrate*, seldom sub-cucullate; stomata in one row; *lid with a short straight or oblique beak about 0.75 mm. long* (or short and obtuse in the f. *obtus*); annulus broad, revoluble, of 3–4 rows of cells; peristome teeth reddish, papillose, 2–3-cleft at the apex, slightly perforated, seldom entire, spreading when dry, conspicuously trabeculate; spores yellowish brown, nearly smooth or somewhat granular, 9–13  $\mu$  in diameter; winter to spring.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 239; Broth. Musc. Fenn. *pl.* 33 A–E; Braithw. Brit. Moss Fl. 2, *pl.* 48c; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 18 E; Roth, Eur. Laubm. 1, *pl.* 31; E.-P. (Ed. 2) 10, *fig.* 256 F–G; Hedw. Sp. Musc. *pl.* 40, *figs.* 1–3; Loeske, Laubm. Eur. 1913, *figs.* 1h, 16b, 53, 54; Sm. Eng. Bot., *pl.* 1728; Hook. & Tayl. Musc. Brit. (Ed. 2) *pl.* 13; *Pl.* 13.

EXSICCATI.—Baker, Pac. Coast Bry. 290; Macoun, Can. Musci 90, 93, 253; Jepson 62; Bartram 62, 67, 506, 1, 304, 1327, 320, 1383, 1178, 1314, 666, 669 and a dozen others; Loomis and Peebles 5404a, 5845; Pickett 231, 553, 593, 578; Piper 339; Holz. Musci Acro. Bor.-Am. 490.

Common on dry rocks, usually at lower altitudes. This species fruits abundantly in spring and early summer. It differs from *G. orbicularis* in the mitrate calyptra, the rostrate operculum, and the bistratose leaf-margins. British Columbia and Alberta, south to Arizona. Europe. Asia. Africa. Australasia.

### 36. GRIMMIA ORBICULARIS Bruch, in Wils. Eng. Bot. Suppl. *pl.* 2888. 1844.

*Dryptodon obtusus* Brid. Bryol. Univ. 1: 198. 1826, *ex parte*.

*Grimmia pulvinata*, var. *obtus* Hueben. Musc. Germ. 194. 1833.

*Grimmia africana* W.-Arn.; De Not. Syll. 248. 1838.

*Guembelia orbicularis* Hampe, Bot. Zeit. 124. 1846.

Plants in large, compact, fragile, hemispherical, olive green, hoary tufts, 5–10 cm. broad; stems 1–3 cm. long, branched, leafy, bearing rhizoids at base; central strand present; *leaves elliptical or oblong-lanceolate, imbricated when dry, erect-spreading when moist*, the upper ones with long, nearly entire hair points, the lower smaller and muticous or nearly so; *margins plane or slightly recurved near the middle of the leaf, unistratose*; costa thin, percurrent; upper and median cells roundish-quadrate, 9–12  $\mu$  in diameter; median basal cells linear or rectangular, those near the margins more or less quadrate and hyaline. Autoicous; seta yellowish, curved when young, erect or ascending in age; capsule horizontal or pendant, small, ovoid-globose, reddish brown, faintly striate or nearly smooth when dry; *calyptra cucullate*; *lid short, obtuse*; annulus narrow, of 3–4 rows of cells, separating in pieces; peristome pale reddish, teeth lanceolate, finely papillose, 3–4-cleft; spores smooth, yellowish, 10–15  $\mu$  in diameter, in spring.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 240; Braithw. Brit. Moss Fl. 2, *pl.* 48D; Dixon, Handb. Brit. Mosses, (Ed. 3) *pl.* 18F; Roth, Eur. Laubm. 1, *pl.* 31; Loeske, Laubm. Eur. 1913, *figs.* 1g, 2d, 16a, 17f, 54; *Pl.* 12.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 489; on steep, shaded banks of dry washes, in the Tucson Mts., alt. 2300 ft., Pima County, Arizona, Bartram 776, 2, 489, 937, 978; north of Rillito Creek, Pima County, Arizona, alt. 2400 ft., Bartram 63, 504.

*Grimmia orbicularis* is a rare species in North America and is known in the United States only from Mr. Bartram's collections from Arizona, where, he states,\* it is one of the characteristic species of the moss flora of that region, growing abundantly at altitudes below 2,500 ft. Otherwise, this species is known from Mexico, Europe, Asia, and Africa.

It grows in larger, darker colored patches than *G. pulvinata*. The leaves are smaller and narrower, with the margins not thickened; the capsules are smaller, brighter reddish and nearly smooth when dry, and the calyptra is cucullate. It has been confused with the forma *obtus* of *G. pulvinata*, but in that plant the calyptra is mitrate, the lid is short and obtuse, and the leaves have thickened margins.

### Subsection 2. TORQUATAE (Hagen) Loeske, Laubm. Eur. 1: 153. 1913.

Dioicous; leaves lanceolate, acuminate, gradually piliferous, spirally twisted around the stem, and sometimes crisped when dry; gemmae sometimes present on the leaves; stems triangular in cross section; plants usually sterile; peristome poorly developed.

\* Bryologist, 27: 10. 1924.

## 37. GRIMMIA TORQUATA Hornsch. in Grev. Scot. Crypt. Fl. 4: 199. 1826.

*Dryptodon torquatus* Brid. Bryol. Univ. 1: 772. 1826.*Zygodon torquatus* Liebm. Wickstroem. Jahresb. 430. 1840.*Grimmia torta* Nees, Hornsch. & Sturm, Bryol. Germ. 2: 179. 1827.*Grimmia streptophylla* Kindb. Bot. Not. 187. 1882.*Grimmia tortifolia* Kindb. Enum. 1888.*Grimmia prolifera* C. M. & Kindb. Mac. Cat. Can. Pl. 6: 67. 1892.*Grimmia tortifolia*, subsp. *pellucida* Kindb. Eur. & N. Am. Bryin. 217. 1897.

Plants densely pulvinate, in large, soft, fragile, yellowish green tufts; stems 1–5 cm. high, bearing rhizoids at the base, reddish brown, erect, slender-branched, leafy, triangular in cross section, parenchyma yellowish and thick walled; leaves small, 0.7–1.5 mm. long, spirally twisted and contorted when dry, erect-ascending when moist, linear-lanceolate, and on sterile plants frequently bearing roundish or filamentous gemmae on the costa on the lower side of the upper leaves; lower leaves muticous, the upper with a short, flat, hyaline apex; margins plane or slightly reflexed, bistratose; costa prominently convex on the dorsal side of the leaf; leaves unistratose, or near the apex bistratose; cells incrassate, more or less sinuose, the upper ones roundish, 8–12  $\mu$  in diameter; basal cells rectangular. Dioicous; seta arcuate when young, erect, or ascending and flexuose when mature, 3–5 mm. long; capsule ellipsoidal when young, becoming cylindrical, pale brown and longitudinally furrowed when old; lid with a straight, slender beak; stomata in one row at the base of the capsule; annulus narrow, the cells in 1–3 rows, deciduous in fragments with the lid; calyptra small, brownish, mitrate; peristome fugacious, teeth short, reddish, with a median line, irregularly 2-cleft; spores smooth, 9–11  $\mu$  in diameter, spring to summer.

Type locality, "auf den höchsten Alpen in Kärnten."

ILLUSTRATIONS.—Limpr. Laubm. Eur. 1, fig. 202; Braithw. Brit. Moss Fl. 2, pl. 47e; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 18D; Roth, Eur. Laubm. 1, pl. 32; Loeske, Laubm. Eur. 1913, figs. 17L, 35g, 51; Grev. Scot. Crypt. Fl. pl. 199; Pl. 15.

EXSICCATI.—Drumm. Musc. Am. 58; Macoun, Can. Musci 257, 268, 95; Holz. Musci Acro. Bor.-Am. 237, 380; Foster 480; Allen, Mosses Casc. Mts., 28; Gardner 54; Pedersen 3854.

On alpine rocks, rare and usually sterile; Alaska to California and Wyoming; Greenland, Europe.

Although this species was discovered as early as 1817, it was not known in the fruiting condition until 1888, when John B. Leiberger collected specimens bearing capsules on granite ledges near Lake Pend d'Oreille, Idaho. The first European fruiting plants were found in Norway by E. Ryan in 1892. In 1893, fruiting plants were collected in Wyoming by Roell,\* and the third North American collection bearing capsules was made in 1898 in the upper Nisqually Valley, Mt. Rainier, Washington, by J. A. Allen.

This Arctic-alpine species, this "muscus pulcherrimus distinctissimus," as Schimper† called it, is not likely to be confused with any other *Grimmia*, unless it may be *G. funalis*, a species which is as yet known to occur in the western hemisphere only in Greenland. From that species, *G. torquata* is readily distinguished by the large, loose, soft, yellowish green tufts, and the often gemmiferous leaves, which when dry, are twisted and spirally contorted, while the plants of *G. funalis* occur in dense, smooth, gray or blackish tufts, the leaves are non-gemmiferous, and when dry, are spirally inrolled on the stem.

On August 10, 1897, Professor J. B. Flett collected an anomalous specimen near one of the steam jets issuing from a fissure in the side of the rim of the crater at about 14,000 feet elevation near the summit of Mount Rainier, Washington. This specimen was described by Holzinger as *Rhacomitrium Flettii*, (Bryologist 7: 41. pl. 5. 1904) and, a year later, as *Grimmia Flettii* (op. cit. 8: 54. 1905). According to Holzinger (l. c. 41), "In appearance, color and branching it looks like a diminutive form of *Rhacomitrium ellipticum* . . . But it has almost completely lost the very unequal thickenings of the cell walls above the base, has narrower leaves lacking the foldings in that species, has a heavier costa, and has a tendency to a doubling of the small marginal cells." Cardot, who examined a part of the type, thought that it is new, and that it is closely related to *G. torquata* Hornsch. No recent collections have been made and therefore the status of *G. Flettii* remains obscure. Holzinger's description is as follows:

"Stems densely caespitose, radiculose at base, simple or fasciculately branched; color of plants yellowish brown; leaves divergent, then ascending when moist, lanceolate, margin entire; costa reaching apex; cells at base pellucid, thin-walled, approximately rectangular, about 1 x 2, above more isodiametric, thick-walled, with a row of more pellucid, smaller, roundish cells along the margin and this bistratose toward the apex. Entirely sterile." Pl. 13.

\* Roell, Julius, Nordamerikanische Laubmoose, Torfmoose und Lebermoose, Hedwigia 32: 208. 1893.

† Schimper, W. Ph. Synopsis muscorum europaeorum, (Ed. 2) 1: 254. 1876.

## 38. GRIMMIA FUNALIS (Schwaegr.) Schimp. Syn. 211. 1860.

- Trichostomum funale* Schwaegr. Suppl. 1: 150. 1811.  
*Trichostomum patens*  $\beta$  *funalis* Hook. & Tayl. Musc. Brit. 60. 1818.  
*Campylopus funalis* Brid. Mant. 75. 1819.  
*Dryptodon funalis* Brid. Bryol. Univ. 1: 193. 1826.  
*Dryptodon spiralis* Brid. l. c. 771.  
*Grimmia cernua* Nees, Hornsch. & Sturm, Bryol. Germ. 2: 174. 1827.  
*Grimmia incurva*  $\beta$  *spiralis* Hueben. Musc. Germ. 191. 1833.  
*Rhacomitrium funale* Hueben. l. c. 200.  
*Grimmia spiralis* Hook. & Tayl. in Drumm. Musc. Scot. 2: No. 29.

Plants in dense, fragile, grayish green or blackish tufts; stems slender, 1–5 cm. high; central strand well developed; leaves appressed and spirally inrolled on the stem when dry, erect-ascending when moist, ovate-lanceolate, 1–1.5 mm. long; hair point variable in length, smooth; costa convex on the dorsal side of the leaf; upper leaf cells sinuose, incrassate, roundish-quadrate, 7–9  $\mu$  in diameter; basal cells rectangular, or those near the costa linear, those near the margins quadrate, smooth walled, pellucid. Dioicous; seta 1–2 cm. long, curved, yellowish; capsule pendent, small, ovoid, brownish, faintly longitudinally sulcate when dry; calyptra mitrate, lobed at base; lid conical, obtuse; annulus broad, deciduous, of 3–4 rows of small cells; stomata few, large; peristome teeth small, reddish, papillose, cribrose, or 2-cleft to the middle; spores yellowish green, granulose, 14–18  $\mu$  in diameter, summer to autumn.

Type locality, "der subalpinen Region des Riesengebirges [Bohemia-Prussia] von C. Ludwig entdeckt."\*

ILLUSTRATIONS.—Bryol. Eur. pl. 242; Broth., Laubm. Fenn. fig. 32 K–M; Braithw. Brit. Moss Fl. 2, pl. 47D; Dixon, Handb. Brit. Mosses, (Ed. 3) pl. 18C; Roth, Eur. Laubm. 1, Pl. 32; Loeske, Laubm. Eur. 1913, figs. 17h, 25c, 35f; Schwaegr. Suppl. 1, Pl. 37; Pl. 13.

According to Paris,† and Macoun,‡ this species has been collected in Greenland at Smith's Sound, and at Scoresby Sound. No continental North American specimens have been seen and this description is, therefore, drawn from European specimens. This species is known also from Asia and Africa.

## 39. GRIMMIA HAMULOSA Lesq. Mem. Calif. Acad. 1: 14. 1868.

Plants blackish, loosely tufted; stems dichotomously branched; leaves mulicous, 2–3.5 mm. long, unequally imbricated, subfasciculate, homomallous-falcate when dry, subhomomallous, erect and uncinatate when moist, linear-subulate, canaliculate; costa stout, subpercurrent; margins plane; upper and median leaf cells irregularly roundish-quadrate, basal cells rectangular; perichaetial leaves longer. Dioicous; seta arcuate; capsule ovoid, smooth, emergent, brownish; annulus none; peristome teeth short, cleft or cribrose.

Type locality, gravelly soil, Mount Dana, California, elevation 10,000 feet, collected by H. N. Bolander.

ILLUSTRATIONS.—Pl. 25.

EXSICCATI.—Cisco, Placer County, California, June, 1909, W. A. Setchell; Yosemite Point, California, June, 1923, Hirstel 305.

On rocks, California. This species resembles *G. incurva* Schwaegr., but differs in the longer, homomallous-falcate, uncinatate leaves, and the emergent capsule which lacks an annulus.

## 40. GRIMMIA INCURVA Schwaegr. Suppl. 1: 90. 1811.

- Dicranum contortum* Wahlenb. Fl. Carpat. 346. 1814.  
*Grimmia uncinata* Kaulf. in Sturm, Fl. Deutschl. 2: 1815.  
*Campylopus contortus* Brid. Mant. 74. 1819.  
*Dryptodon contortus* Brid. Bryol. Univ. 1: 199. 1826.  
*Grimmia contorta* Schimp. Syn. (Ed. 1) 209. 1860.  
*Grimmia Hagenii* Kaur. Nyt. Mag. for Naturv. 31: 217. 1888.

Plants in short dense rounded cushions 5–10 cm. broad, dark green; stems 1–3 cm. high, blackish green and radiculose at base, erect, with central strand and loose parenchyma; leaves strongly twisted and curled when dry, spreading or curved when moist, linear, from a lanceolate base, 1.5–2 mm. long, the lower smaller and

\* Limpricht, Die Laubmoose Deutschlands, etc., 1: 774. 1889.

† Paris, E. G., Index Bryologicus (Ed. 2) 2: 274. 1904.

‡ Macoun, John, Catalogue of Canadian Plants 6: 67. 1892.

muticous; margins plane or slightly recurved near the middle of the leaf; hair points short, almost smooth; upper leaf cells small and sinuose, 8–10  $\mu$  in diameter, median cells quadrate or oval, basal cells elongated, rectangular or linear, somewhat hyaline; perichaetial leaves longer with longer hair points which extend to the capsule. Dioicous; seta at first curved, later upright, yellowish, 2–3 mm. long; capsule smooth, ellipsoidal, yellowish green, becoming brownish and somewhat longitudinally sulcate with age; calyptra mitrate; lid conical; annulus broad, of 3–4 rows of cells; stomata large, in 1 row; peristome reddish, papillose, teeth entire or irregularly perforated to the middle, seldom cleft; spores yellowish brown, smooth, 9–12  $\mu$  in diameter, in summer.

Type locality, "auf dem Grossglockner in Kärnten" (Austria). Discovered by Schwaegrichen.

ILLUSTRATIONS.—Braithw. Brit. Moss Fl. 2, pl. 47B; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 18B; Roth, Eur. Laubm. 1, pl. 32; Loeske, Laubm. Eur. 1913, fig. 36; Schwaegr. Suppl. 1<sup>3</sup>, pl. 97; Pl. 14.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 286.

On non-calcareous rocks in mountainous regions, seldom fruiting. British Columbia to California; Greenland; Europe; Asia.

Subsection 3. TRICOPHYLLAE Hagen, Kong. Norske Vidensk. Selsk. Skrift. 1909, No. 5: 37. 1909.

Dioicous (or autoicous); leaves narrowly lanceolate, gradually acuminate to a piliferous point, imbricated, crisped or falcate when dry, but not spirally twisted around the stem; stems terete; gemmae sometimes present on the leaves; plants usually fertile; peristome normally developed.

#### 41. GRIMMIA TRICOPHYLLA Grev. Fl. Edin. 235. 1824.

*Dicranum pulvinatum*  $\beta$  *argentatum* Turn. Musc. Hib. 78. 1804.

*Dryptodon trichophyllus* Brid. Bryol. Univ. 1: 771. 1826.

*Grimmia Schultzii* ex p. Hueben. Musc. Germ. 195. 1833.

*Grimmia californica* Sull. Pac. R. R. Rept. 4: 187. 1856.

*Grimmia canadensis* Kindb. Eur. & N. Am. Bryin. 226. 1897.

*Grimmia cognata* Card and Thér. Bot. Gaz. 37: 368. 1904.

*Grimmia trichophylla*, subsp. *eutrichophylla* Loeske, Laubm. Eur. 1: 128. 1913.

Plants in loose, yellowish green tufts, blackish at base; stems 1–3 cm. long, erect or ascending; leaves imbricated or slightly twisted when dry, ascending when moist, linear-lanceolate from a narrowly ovate-lanceolate base, 2–2.5 mm. long, 2–3-stratose, those near the base of the stem smaller; hair point entire or weakly toothed; costa strong, prominently convex and sometimes channelled on the dorsal side of the leaf; one or both margins recurved below; leaf cells somewhat sinuose and incrassate; upper cells roundish or quadrate, 7–9  $\mu$  in diameter, often obscure and opaque; basal cells variable, usually narrowly rectangular or linear, more or less sinuose and incrassate or sometimes smooth-walled, those at the margins shorter and wider, more or less hyaline. Dioicous; antheridia without paraphyses; seta 3–5 mm. long, at first curved downward, becoming ascending or erect, flexuose, yellowish green; capsule horizontal or pendent, ellipsoidal, thin walled, yellowish green at first, brown and more or less distinctly ribbed in age; stomata in 2 rows; annulus distinct, broad, of 4–5 rows of large cells, separating in pieces; lid variable, usually with a straight beak about 1 mm. long; calyptra mitrate or subcucullate; peristome teeth reddish, cuneate, 2–3-cleft to the middle, papillose, erect-spreading when dry; spores 10–15  $\mu$  in diameter, yellowish brown, papillose, in spring.

Type locality, "on stone walls at the foot of Arthur's Seat," Edinburgh, Scotland. Discovered by Greville.

ILLUSTRATIONS.—Bryol. Eur. pl. 244; Braithw. Brit. Moss Flora, 2, pl. 48E; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 18G; Roth, Eur. Laubm. 1, pl. 32; Loeske, Laubm. Eur. 1913, fig. 37; Hook. & Tayl. Musc. Brit. (Ed. 2) pl. 2; Pl. 14.

EXSICCATI.—Macoun, Can. Musci 262, 94, 263, 265a; Holz. Musci Acro. Bor.-Am. 138; Grout, N. Am. Musci Perf. 98; Allen, Mosses Casc. Mts. 27; Henderson 12087, 12161, 12111, 12151, 11964; Nelson 57; Gardner 31, 1238; Bolander 16; Howe 64; Baker, Pac. Coast Bry. 762; Bartram 1045; Pickett 219.

This is a common and variable species, occurring on siliceous rocks in western North America, from southeastern Alaska to California and Colorado. It is found also in Europe, Asia, Africa, and Australasia.

#### 41a. Var. MUEHLENBECKII Husn. Musc. Gall. 135. 1887.

*Campylopus pulvinatus*, var. *tenuis* Wahlenb. Fl. Suec. 2: 748. 1826.

*Dryptodon Schultzii* Hartm. Skand. Fl. 373. 1843.

- Grimmia rugulosa* Lindgr. Bot. Not. 88. 1845.  
*Grimmia incurva* Bryol. Eur. fasc. 25-28. pl. 8 (243). 1845.  
*Grimmia Hartmani* Schimp. Coroll. 47. 1856.  
*Grimmia trichophylla*, var. *septentrionalis* Schimp. Coroll. 47. 1856.  
*Grimmia Muehlenbeckii* Schimp. Syn. (Ed. 1) 212. 1860.  
*Grimmia trichophylla*, subsp. *Muehlenbeckii* Dixon, Stud. Handb. Brit. Mosses, (Ed. 1). 1896.

Plants in dark green or blackish green tufts; stems 10-25 mm. long, erect or ascending; leaves crowded, erect when dry, spreading when moist, and curved upward from the middle, lanceolate, acuminate to a usually spinulose hair point; margins plane or slightly recurved at middle; costa strong, prominent in the upper half of the leaf; upper cells roundish-quadrate, bistratose; basal cells quadrate or shortly rectangular, sinuose, 1-3 rows at margin shorter and hyaline; capsule small, ovoid, rugulose when dry; annulus narrow, of 2-3 rows of cells; lid with a short beak; peristome teeth nearly entire, cuneiform.

Type locality, "bei Trafoi in Tirol" (Italy). Discovered by Muehlenbeck in 1840.

ILLUSTRATIONS.—Bryol. Eur. pl. 243 (as *G. incurva*); Braith. Brit. Moss Fl. 2: pl. 48a; Dixon, Handb. Brit. Mosses (Ed. 3), pl. 18H; Roth, Eur. Laubm. 1: pl. 32; Loeske, Laubm. Eur. 1913, figs. 23f, 39.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 158; Leiberg 3; Eastwood 151; Ashton 278.

On basalt, granite, sandstone, and other rocks in western North America, from British Columbia to California and Colorado. Professor C. L. Porter of the University of Wyoming informs me that this plant occurs on the highest peaks in Colorado and is the only member of the genus to be found at all commonly above timberline, 11,000-12,200 feet.

This variety is generally darker colored, with broader leaves which have the basal cells shorter and the hair points strongly spinulose, although many specimens show the amount of denticulation to be variable. Some leaves have the aristae almost smooth, while the other parts of the plant show the characters of the var. *Muehlenbeckii*. The capsules are characteristically smaller and shorter and the annulus is narrower, less distinct, and persistent. The habit of the plant tends to be pulvinate rather than cespitose. This variety is apparently much less common in North America than is typical *G. trichophylla*.

41b. Var. *MERIDIONALIS* Schimp. Syn. (Ed. 2) 256. 1876.

- Grimmia Lisae* De Not. Spicil. No. 15. 1837.  
*Grimmia sardoa* De Not. C. Muell. Syn. 1: 786. 1849.  
*Grimmia ancistrodes* Mont. Syll. 35. 1856.  
*Grimmia trichophylla*, subsp. *lusitanica* Schimp. Syn. (Ed. 2) 257. 1876.  
*Grimmia Watsoni* Lesq. & James, Man. Mosses N. Am. 140. 1884.  
*Grimmia trichophylla*, subsp. *sardoa* Bottini, in Loeske, Laubm. Eur. 1: 133. 1913.  
*Grimmia trichophylla*, subsp. *Lisae* Bottini, l. c.  
*Grimmia trichophylla*, subsp. *meridionalis* Loeske, Mon. Eur. Grimm. 171. 1930.

Plants more densely tufted than in typical *G. trichophylla*. The stems are longer and more slender. The leaves are shorter and are arcuately recurved when moist, while in the typical form of the species and in the var. *Muehlenbeckii* they are scarcely recurved when moist, except at the tips. The capsules are ovoid or subglobose, less distinctly costate, and the peristome is shorter.

This is a southern variety of *G. trichophylla*, known in North America only from California.

ILLUSTRATIONS.—Pac. R. R. Rept. 4: pl. 4, figs. 1b, 3b.

EXSICCATI.—California, Bolander, without definite locality.

42. GRIMMIA OLNEYI Sull. Mosses U. S. 37. 1856.

*Grimmia Austini* Kindb. Rev. Bryol. 23: 19. 1896.

This species is similar to *G. trichophylla*, but the plants are less robust; stems shorter, more strict, erect or nearly so, often leafless at base; leaves canaliculate-concave, spinulose-piliferous, not recurved on the margins, linear-lanceolate from an ovate base, 2-3 mm. long, more rigid than those of *G. trichophylla*, not falcate or hooked, with a denser, more compact areolation; upper and median leaf cells densely opaque, 6-9  $\mu$  in diameter, basal leaf cells mostly thin- and smooth-walled, not, or scarcely sinuose or incrassate; costa obscure in the upper part of the leaf; capsules smooth, ellipsoid, or ovoid, yellowish green; lid with a shorter beak; calyptra subcucullate; spores in early spring.

Type locality, Smithfield, Rhode Island, collected by Olney.

ILLUSTRATIONS.—Sull. Icones *pl.* 42; Grout, M. H. M. *pl.* 19.

EXSICCATI.—Sull. & Lesq., Musc. Bor.-Am. (Ed. 1) 141, (Ed. 2) 209; Aust. Musc. Appal. 144, 145; Fernald, Bartram & Long 782; Schalbert 3063; Bartram 534, 942; Bartram & Chamberlain 1047; Ren. & Card., Musci Amer. Sept. 169.

On non-calcareous rocks at lower elevations, Nova Scotia to Ontario, south to Georgia.

43. GRIMMIA LEIBERGH Paris, Index Bryol. (Ed. 1) 528. 1895.

*Grimmia pachyphylla* Leib. Bull. Torr. Club 20: 113. 1893. Not C. Muell. 1885.

Plants in irregular tufts, yellowish green or brownish green, blackish at base; stems erect, robust, 5–12 cm. long, dichotomously branched, bearing rhizoids; central cylinder distinct; *leaves lanceolate, imbricated when dry*, bistratose in the upper half, acuminate, 2–3.5 mm. long, the lower ones much smaller; hyaline hair points spinulose; margins strongly revolute; costa broad, sometimes channelled on the back; cells not papillose, the median and upper ones quadrate or shortly rectangular, strongly sinuose and incrassate; basal cells smooth walled, the juxtacostal ones linear, those near the margins and in the basal angles shortly rectangular or quadrate. *Dioicous*; antheridial plants mixed with the archegonial plants but usually somewhat shorter and more branched, occurring but sparingly; antheridial buds in the axils of the innovations, occasionally terminal on very short lateral branchlets; antheridia numerous, lacking paraphyses; archegonial inflorescence from secondary branches, sometimes direct from the axils of the innovations; seta 0.5–1 cm. long, arcuate, sometimes in pairs; *capsule* 2–4 mm. long, ellipsoid, *4–8-striate and sulcate when dry*; calyptra mitrate; lid subulate-beaked; *annulus of 2 rows of cells, persistent*; peristome teeth 0.5 mm. long, densely but minutely papillose, 2–3-cleft to the middle or lower into unequal, filiform divisions, incurved when dry; spores reddish brown, nearly smooth, 14–16  $\mu$  in diameter.

Type locality, "Habitat granite, gneissoid and slate rocks throughout Kootenai County, Idaho."

ILLUSTRATIONS.—Bull. Torr. Club 20, *pl.* 144; *Pl.* 15.

EXSICCATI.—Leiberg 250; Sandberg, MacDougal & Heller 1169.

Identical with *G. decipiens* (Schultz) Lindb., except in its dioicous inflorescence and the simple, persistent annulus. The characters of "open leaf base, smoother hairy point, its broader basilar, its shorter medial, and its quadrate apical areolation, its pluri-stratose nerve, the longer beak of the lid . . . and the peristome incurved when dry," which are mentioned in the original description, are of slight value as specific characters. It is not altogether improbable that further study will lead to the conclusion that *G. Leibergii* should be included with *G. decipiens*.

44. GRIMMIA DECIPIENS (Schultz) Lindb. in Hartm. Skand. Fl. (Ed. 8) 386. 1861.

*Trichostomum decipiens* Schultz, Suppl. Fl. Starg. 70. 1817.

*Dryptodon Schultzii* Brid. Bryol. Univ. 1: 199. 1826.

*Trichostomum patens*  $\beta$  *piliferum* Hook. & Tayl. Musc. Brit. (Ed. 2) 105. 1825.

*Grimmia Schultzii* Hueben. Musc. Germ. 195. 1833, ex p.

*Grimmia funalis* Bryol. Eur. 3: (fasc. 25–28) 17. 1845.

*Grimmia trichophylla* Rabenh. Deutschl. Fl. 2<sup>3</sup>: 162. 1848.

*Grimmia robusta* Ferg. mss. Braithw. Journ. Bot. 196. 1872.

*Grimmia Hendersoni* Ren. & Card. Rev. Bryol. 19: 86. 1892.

*Grimmia decipiens*, subsp. *robusta* Dixon, Stud. Handb. Brit. Mosses (Ed. 1). 1896.

Plants robust, yellowish or brownish green, in loose, spreading, fragile tufts; stems 2–4 cm. long, erect or ascending, dichotomously branched, rhizoids few; central strand distinct; *leaves imbricated when dry*, lanceolate, bistratose in the upper half, acuminate, 2–3.5 cm. long; hyaline hair point spinulose; margins revolute; costa strong; cells sinuose, not papillose, the upper and median ones roundish-quadrate; basal cells yellowish green, shortly rectangular or quadrate. *Autoicous*; antheridial buds axillary; antheridia numerous, with few paraphyses; seta 2–4 mm. long, arcuate; *capsule* 1.5 mm. long, pendent, ellipsoid, *8-ribbed, and brownish when dry*; lid with a long, straight, subulate beak; *annulus of 3–4 rows of cells, deciduous*; peristome teeth erect when dry, 0.5 mm. long, reddish, densely papillose, 2–3-cleft to the middle or below into filiform, unequal divisions; spores reddish brown, slightly granulose, 14–18  $\mu$  in diameter, in spring.

Type locality, Mecklenburg, Germany. Collected by C. F. Schultz in 1819.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 247; Braithw. Brit. Moss Fl. 2, *pl.* 49B; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 18K; Roth, Eur. Laubm. 1, *pl.* 29, 31; Loeske, Laubm. Eur. 1913, *figs.* 17i, 47; *Pl.* 16.

EXSICCATI.—Baker, Suppl. Pl. Pac. Coast 3645.

On siliceous rocks, Oregon and California; rare in North America.

45. GRIMMIA Densa Kindb. Bull. Torr. Club 17: 271. 1890.

*Grimmia depilata* Kindb. Mac. Cat. Can. Pl. 6: 69. 1892.

Plants in large, compact, dense tufts; stems 2–3 cm. long; *leaves erect-spreading or arcuate when moist, imbricated when dry, not crisped, mucous, lanceolate, acute or obtuse, non-papillose, 2–3.5 mm. long; one or both margins recurved, at least in the lower half of the leaf; upper and median leaf cells roundish quadrate, 6–8  $\mu$  in diameter; basal cells yellowish green, incrassate, sinuose, the juxtacostal cells rectangular or linear, becoming quadrate toward the margin; perichaetial leaves sheathing at the base, long acuminate. Dioicous; seta arcuate, 5–8 mm. long; capsule ellipsoidal, striate and sulcate when dry, but non-costate, yellowish brown; annulus of 3 rows of cells; lid subulate; peristome teeth irregularly 2–4-cleft to the middle or below, reddish, spreading when dry; spores 10–15  $\mu$  in diameter.*

Type locality, summit of Mount Benson, near Nanaimo, Vancouver Island, British Columbia, Canada, altitude 3,000 feet, John Macoun, June 8, 1887, and not otherwise known. The phylogenetic status of these plants is difficult to determine with any appreciable degree of accuracy. They closely simulate *G. Hartmani*, but more material is necessary for a satisfactory disposition.

EXSICCATI.—Macoun, Can. Musci 263 (type).

46. GRIMMIA HARTMANI Schimp. Syn. (Ed. 1) 214. 1860.

*Grimmia incurva* Hartm. Skand. Fl. (Ed. 5) 376. 1849.

*Grimmia Lubtumedae* (subtunida) Schimp. in Rabenh. Bryoth. Eur. 510. 1862.

*Grimmia sphaerocarpha* Stirt. Scot. Nat. 9: 36. 1887.

*Dryptodon Hartmani* Limpr. Laubm. 1: 789. 1889.

*Grimmia Hartmannii*, subsp. *vulgaris* Loeske, Mon. Eur. Grimm. 177. 1930.

Plants in loose, wide, yellowish green tufts; stems 2–8 cm. long, ascending, leafy above, somewhat branched, leafless, blackish green and bearing rhizoids at base; central strand absent; *leaves erect or the upper ones somewhat falcate-secund when moist, slightly twisted when dry, 2–3 mm. long, unistratose, except on the margins, lanceolate from an ovate base, acute, some of the terminal leaves usually with apical, globular clusters of brown gemmae; costa pale green, prominent on the dorsal side of the leaf; hyaline point very short, smooth, or slightly spinulose; margin recurved on one side of the leaf, 2–3-stratose; upper cells irregular, incrassate, not papillose, more or less sinuose, roundish-quadrate, 6–9  $\mu$  in diameter; basal cells rectangular, incrassate, slightly sinuose, about 3–6 : 1, those near the leaf-margins shorter and wider, with thinner walls. Dioicous; antheridia and archegonia terminal; antheridia numerous, orange; paraphyses none; seta somewhat curved, 3–4 mm. long, becoming erect in age; capsule smooth, ellipsoidal, 1.5–2 mm. long; calyptra cucullate-mitrate; lid short beaked; annulus not differentiated (of 3–4 rows of small cells according to Braithwaite)\* peristome reddish, teeth lanceolate, entire or slightly perforated at apex and slightly papillose; spores somewhat granular, 12–15  $\mu$  in diameter.*

Type locality, "in den Wäldern der Vogesen und auf erratischen Gestein bei Mornai am Südgehänge des Salève in der Schweiz." Discovered by W. Ph. Schimper.

ILLUSTRATIONS.—Braithw. Brit. Moss Fl. 2, 18F; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 19c; Loeske, Laubm. Eur. 1913, *figs.* 39, 41, 42; *Pl.* 16.

EXSICCATI.—On rock cliffs, San Antonio Canyon, altitude 2000 ft., Claremont, Los Angeles County, California, October 11, 1929, F. R. Fosberg 214.

46a. Var. ANOMALA (Hampe) Moenk. Laubm. Eur. 369. 1927.

*Grimmia anomala* Hampe, apud Schimp. Syn. (Ed. 2) 270. 1876.

*Grimmia Philibertiana* E. G. Britt. Bull. Torr. Club. 18: 51. 1891.

*Grimmia phyllantha* Lindb. in Broth. Enum. Musc. Caucas. 83. 1892.

\* Braithwaite, Brit. Moss Flora 2: 21. 1888.

*Dryptodon anomalus* Loeske, Hedwigia 49: 32. 1910.

*Grimmia Hartmanii*, var. *alpinoborealis* Loeske, Laubm. Eur. 1: 141. 1913.

*Grimmia Hartmanii*, subsp. *anomala* Loeske, Mon. Eur. Grimm. 182. 1930.

Plants in loose, fragile, dark green tufts; stems ascending, 2-4 cm. long, simple or branched, leafless at base, leafy above; central strand present; leaves lanceolate, broader than in the typical form of the species, loosely imbricated or slightly contorted when dry, erect-ascending when moist, 1.7-2.5 mm. long, obtuse, usually with numerous, many-celled, yellowish green gemmae; hair point short and spinulose, or absent; margins revolute, at least on one side of the leaf near apex; cells more or less papillose, thickened, roundish-quadrate, 6-8  $\mu$  in diameter, those at the base quadrate or shortly rectangular, 10-15  $\mu$  long; seta 3-5 mm. long, more or less curved; capsule ellipsoidal, 1 mm. long, smooth when dry; peristome teeth reddish, entire; annulus persistent; lid with a long straight beak; calyptra mitrate.

Type locality, "An feuchten Felsen bei Zermatt im Wallis, wo Sie im August 1873 von Pastor Bertram (Braunschweig) entdeckt wurde." (fide Limpricht, Laubm. 1: 768).

EXSICCATI.—On the divide between Traille River and Independence Creek, Idaho, altitude 6,000 feet, September 27, 1889, J. B. Leiber 219. This is apparently the only record for North America.

#### 47. GRIMMIA ELATIOR Bryol. Eur. fasc. 25-28. pl. 16. 1845.

*Trichostomum incurvum* Hoppe & Hornsch. Fl. 1: 89. 1819.

*Dryptodon incurvus* Brid. Bryol. Univ. 1: 194. 1826.

*Rhacomitrium incurvum* Hueben. Musc. Germ. 201. 1833.

*Grimmia funalis*  $\beta$  *robusta* De Not. Syllab. 251. 1838.

*Grimmia funalis* \**elatior* Hartm. Skand. Fl. (Ed. 5) 376. 1849.

*Grimmia elata* Kindb. Rev. Bryol. 17: 33. 1905.

Plants robust, in broad, loose, hoary, fragile tufts; stems ascending, dichotomously branched, 3-7 cm. long, leafy above, leafless, radiculose, and blackish below; central strand present; leaves appressed when dry, erect-spreading when moist, 2-4 mm. long, elongate-lanceolate, from an oblong and somewhat plicate base, 2-3-stratose; hair point short, smooth or sparingly spinulose; one margin strongly revolute, the other often plane, both 3-5-stratose; costa strong, prominently convex on the dorsal side of the leaf; upper cells roundish-quadrate, sinuose, incrassate, 9-11  $\mu$  in diameter, irregularly papillose; basal cells linear, sinuose, yellowish, those near the margins somewhat shorter. Dioicous; seta 2-3 mm. long, curved; capsule horizontal or pendent, ellipsoid, pale brown, sulcate when dry; calyptra mitrate; lid short beaked; annulus of 3-4 rows of cells, revolute; peristome teeth reddish, weakly papillose at apex, cribose or irregularly 2-3-cleft, closely articulated; spores somewhat granular, brownish green, 10-12  $\mu$  in diameter, in spring.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. pl. 245; Broth. Laubm. Fenn. fig. 33 F-H; Braithw. Brit. Moss Fl. 2, pl. 49c; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 19B; Roth, Eur. Laubm. 1, pl. 32; Loeske, Laubm. Eur. 1913, figs. 17K, 23G, 47; Pl. 16.

EXSICCATI.—On rocks, Mount Alymer, Macoun 261.

On non-calcareous rocks in the alpine regions of Alaska, Yukon, British Columbia, and Greenland. Also in Europe and Asia.

#### Subfamily 2. SCOULERIEAE.

Dioicous, cladocarpous species; central cylinder of the stem undifferentiated; stems elongated, irregularly branched; leaves costate, muticous; perichaetial leaves not convolutely clasping the seta; capsule immersed; columella elongated, persistently attached to the lid; calyptra cucullate; hydrophytic species.

#### 3. SCOULERIA Hook. Bot. Misc. 1: 33. 1830.

Large hydrophytic, rupestral mosses growing in loose, blackish green tufts; stems elongated, bearing rhizoids at base; leaves imbricated when dry, lanceolate or lingulate, thickish, obtuse, the upper ones more or less toothed; leaf cells small, roundish-hexagonal, chlorophyllose, smooth, those at the basal angles of the leaf quadrate; costa with some rhizoids at base; dioicous; seta short; capsules erect on short lateral branchlets, immersed or emergent, oblate-spheroidal, dark brown or blackish, glossy; annulus undifferentiated; peristome teeth when present, inserted under the mouth of the capsule, short, entire, cribose or

cleft at the apex; spores 35–60  $\mu$  in diameter, calyptra cucullate; columella elongated, persistently attached to the flat lid.

A genus of five species in North and South America. Type species, *Scouleria aquatica* Hook.

Peristome present; leaf margins unistratose. . . . . 1. *S. aquatica*.  
Peristome absent; leaf margins bistratose. . . . . 2. *S. marginata*.

#### 1. SCOULERIA AQUATICA Hook. Bot. Misc. 1: 33. 1830.

*Grimmia Scouleri* C. Muell. Syn. 2: 654. 1851.

*Scouleria aquatica*, var. *virescens* Kindb. Bull. Torr. Club 16: 93. 1889.

*Scouleria aquatica*, var. *nigrescens* Kindb. Bull. Torr. Club 16: 94. 1889.

*Scouleria Nevii* C. Muell. in Mac. Cat. Can. Pl. 6: 61. 1892.

*Scouleria Muelleri* Kindb. in Mac. Cat. Can. Pl. 6: 62. 1892.

*Scouleria aquatica*, var. *catilliformis* C. Muell. Hedwigia 32: 207. 1893.

Plants gregarious, tufted, dark green or blackish; stems rigid, simple or branched, 5–15 cm. long; leaves becoming abraded in age, only the costae remaining, obtuse at apex, flat or cucullate, dentate or entire; margins unistratose; lower leaves blackish, entire, with yellowish or blackish incrassate cells; upper leaves lighter green, with thinner cell walls; costa thick, subpercurrent, often toothed on dorsal side in upper half of leaf; basal cells rectangular to hexagonal, variable, with a median row of prosenchymatous cells. Dioicous; seta short; capsules nearly immersed, depressed-spheroidal, black; lid flat, remaining attached to the columella; calyptra cucullate; peristome teeth reddish, 16, irregularly divided, often falling with the lid; spores smooth, 35–60  $\mu$  in diameter, maturing in summer.

Type locality, Observatory Inlet, British Columbia, collected by Dr. John Scouler in 1829.

ILLUSTRATIONS.—Broth., E.-P. (Ed. 2) 10, fig. 251; Hook. Bot. Misc. 1, pl. 18; Schwaegr. Suppl. 4<sup>1</sup>, pl. 315; Pl. 18.

EXSICCATI.—Drum. Musc. Am. 63; Macoun, Can. Musci 232, 233, 234, 88, 87, 388; Grout, N. Am. Musci Perf. 119; Allen, Mosses Casc. Mts. 29; Gardner 15; Piper 71; Holz. Musci Acro. Bor.-Am. 287; Henderson 12065; Sandberg and Leiberg 847, 853; Coville 1528; Foster 399.

On rocks in rivers and streams, Alaska, Yukon, and British Columbia to Wyoming and California, locally abundant.

#### 2. SCOULERIA MARGINATA E. G. Britt. Bull. Torr. Club 22: 42. 1895.

Plants similar to *S. aquatica*, but differing in the leaves being bordered by larger, denser cells in a double layer, often prosenchymatous almost to the apex; peristome none; spores minutely roughened; in late summer to autumn.

Type locality, Spokane Falls [Spokane], Washington. Collected by Dr. Sereno Watson, September 24, 1870. Washington to California, on rocks in and along streams and rivers.

ILLUSTRATIONS.—Bull. Torr. Club 22, pl. 227; Pl. 18.

EXSICCATI.—Holz. Musci Bor.-Am. 185; Pickett 674; Piper 226.

#### Subfamily 3. HEDWIGIEAE.

Autoicous species; stems elongated, irregularly branched, with central cylinder undifferentiated; leaves ecostate, usually piliferous; leaf-cells papillose; columella twisted, free from the lid; peristome usually lacking (absent in the North American species) but when present the teeth are entire or cribose and cleft at the apex, not united in pairs and reflexed when dry against the wall of the capsule; spores 18–32  $\mu$  in diameter; xerophytic or mesophytic mosses.

#### 4. BRAUNIA Bryol. Eur. fasc. 29–30. 1846.

*Pseudobraunia* Lesq. & James, Man. Mosses N. Am. 153. 1884 (as subgenus).

*Pseudobraunia* Broth. E.-P., (Ed. 1) 3: 715. 1905 (as genus).

Yellowish green or yellowish brown, caespitose mosses; stems stoloniferous, irregularly branched; leaves concave, often longitudinally sulcate, ovate or oblong-ovate, either with or without hyaline points, margins entire, more or less revolute, seldom plane; leaf cells with simple papillae on both surfaces of the leaf, small,

sinuous, quadrate to rectangular, the upper ones oblong or elliptical; perichaetial leaves larger. Usually autoicous; seta slender, straight or slightly arcuate, twisted to the right when dry; capsule erect, ellipsoidal to cylindrical, smooth, or sulcate when dry; lid short pointed; calyptra smooth, cucullate; spores 18–30  $\mu$  in diameter, yellowish or brownish, smooth or granulose.

There are approximately twenty-five species of this genus. They are for the most part rupestral, seldom arboreal, species and occur mostly in the lower latitudes. In North America, only two species, *B. californica* Lesq., and *B. secunda* (Hook.) Br. & Schimp., are known. The subgenus *Pseudobraunia* of Lesquereaux & James 1884, was raised to generic rank by Brotherus in 1905, but it is probably better treated as a subgenus.

Leaves piliferous; capsule sulcate when deoperculate. . . . . 1. *B. californica*.  
Leaves muticous; capsule smooth. . . . . 2. *B. secunda*.

#### 1. BRAUNIA CALIFORNICA Sull. Trans. Amer. Phil. Soc. 13: 8. 1863.

*Hedwigia pilifera* Mitt. Journ. Linn. Soc. 8: 45. 1865.

*Braunia californica* Lesq., var. *pilifera* Lesq. and James, Man. Mosses N. Am. 153. 1884.

*Pseudobraunia californica* Broth. E.-P. (Ed. 1) 3: 715. 1905.

Plants in loose yellowish green, spreading tufts; stems erect or ascending, sparingly and irregularly branched, stoloniferous; branches erect, julaceous, usually thicker at the tips, simple or further divided into short branchlets; leaves concave, appressed with the tips spreading when dry, erect-patent when moist, ovate or ovate-lanceolate, subdecurrent at base, non-plicate, acuminate to a more or less elongate, hyaline crenulate, flexuous apex; marginal cells quadrate, median cells linear, upper cells fusiform, all papillose with simple papillae; margins recurved, entire; autoicous; antheridia in axillary buds; archegonia terminal on short branches; seta slender, 4–6 mm. long, yellowish green, twisted to the right when dry; capsule terminal, but sometimes appearing lateral owing to the elongation of the branches, erect, exserted, pyriform or turbinate, tapering to the seta, sulcate when dry, truncate and enlarged at the orifice when empty; calyptra large, cucullate, covering the capsule to below the middle, smooth, brownish, 2.5 mm. long; peristome none; lid conical, obtuse, falling with the calyptra; spores yellowish green, smooth, 25–30  $\mu$  in diameter.

Type locality, on metamorphic rocks, up to 3,000 ft. altitude, Mt. Diablo, California. Collected by H. N. Bolander, April 1863.

ILLUSTRATIONS.—Sulliv. Icones, Suppl. pl. 27; Broth. E.-P. (Ed. 2) 11, fig. 482; Mitt. Journ. Linn. Soc. 8, pl. 7; Pl. 19.

EXSICCATI.—Sull. & Lesq. Musc. Bor.-Am. (Ed. 2) 226; Allen, Mosses Casc. Mts. 35; Holz. Musci Acro. Bor.-Am. 210; R. & C. Musc. Am. Sept. 33.

This species is known only from the Pacific Coast of North America, where it occurs on dry rocks from British Columbia to California. In general appearance it resembles *Hedwigia ciliata*, but it differs in the exserted capsules which are sulcate when dry, the large cucullate calyptrae, and the unipapillate leaf-cells.

#### 2. BRAUNIA SECUNDA (Hook.) Bryol. Eur. fasc. 29–30. 1846.

*Hedwigia secunda* Hook. Musc. Exot. pl. 46. 1818–20.

*Anoetangium secundum* Brid. Bryol. Univ. 2: 165. 1827.

*Harrisonia secunda* Spreng. Syst. Veg. 4: 145. 1827.

*Neckera secunda* C. Muell. Syn. 2: 103. 1851.

Plants yellowish green, caespitose; stems prostrate or ascending, irregularly branched, 4–6 cm. long; leaves numerous, crowded, the lower ones erect-patent, the upper secund, ovate, acuminate, somewhat cordate or decurrent at base, slightly oblique, concave, ecostate, muticous, erose or dentate below apex, longitudinally striate or plicate; median and upper leaf cells roundish; basal cells quadrate; margins inflexed. Autoicous; seta erect, smooth; capsule smooth, ellipsoidal or cylindrical; lid subulate; calyptra cucullate; spores in autumn.

Type locality, "In regni Mexicani montosis apricis, iuxta Toluccam, ad radices montis perpetua nive oblecti, regione frigida, altitudine 1640 hexapodum. . . ."

ILLUSTRATIONS.—E.-P. (Ed. 2) 11, fig. 484; Schwaeger. Suppl. 3<sup>1</sup>, pl. 209; Pl. 19.

EXSICCATI.—Holz. Musc. Acro. Bor.-Am. 480 (Bartram 617).

On rocks, Central and South Africa, India, Bolivia, Mexico. This subtropical species is known to occur in North America north of Mexico only in Arizona, where Mr. E. B. Bartram collected it on shaded

rocks in a ravine on Red Mountain, Patagonia Mountains, at altitude of 5,500 feet, in Santa Cruz County, on February 13, 1923.

5. HEDWIGIA Ehrh. Hannov. Mag. No. 69. 1095. 1781; Hedw. Sp. Musc. 40. (as synonym). 1801.

Loosely tufted, grayish green rupestral mosses; stems irregularly branched, leafy, sometimes stoloniferous, sparingly radiculose toward the base; central strand lacking; leaves hyaline-pointed, 8-seriate, concave, ovate, ecostate, papillose, unistratose, yellowish at base; margins revolute, entire; cells quadrate near the leaf margins, linear at base near the costa, upper and median ones roundish; perichaetial leaves larger. Autoicous; archegonia terminal, antheridia axillary; capsule immersed, obovoid to globose, concealed among the perichaetial leaves, erect, symmetrical, pale brown and smooth when dry; seta not longer than the capsule; calyptra minute, glabrous, conical-mitrate, evanescent, reaching only to the base of the lid; lid red, convex; stomata present, usually gymnoporous, in one row near the base of the capsule; peristome lacking; spores 25–32  $\mu$  in diameter, yellowish, with vermiform striations, maturing in spring; annulus undifferentiated.

By some authors, Hedwigia is placed in a separate family, the Hedwigiaceae, and by others in the Cryphaeaceae. Braithwaite considered it to belong to the Neckeraceae. Although the leaves are somewhat similar to those of Cryphaea, there is no further indication of relationship with that genus. *Hedwigia ciliata* is the only species in North America. The foliage is variable according to the habitat, and many varieties have been described. On dry sunny rocks the stems are shorter and more leafy, and the leaves have the hyaline points well developed. In moist situations the plants are more slender, darker green, and the hyaline points of the leaves are short or nearly obsolete. The following key may serve to distinguish these ecological variations, which are here given only formal rank.

Leaves not distinctly longitudinally striate.

Leaves with a short hyaline point, or nearly muticous.

Leaves imbricated or spreading.

Leaves with a short hyaline point. . . . . 1. *H. ciliata*.

Leaves bright green, scarcely hyaline at apex. . . . . 1a. f. *viridis*.

Leaves more or less secund; stems long, slender, prostrate. . . . . 1b. f. *secunda*.

Hyaline point one-third the length of the leaf.

Perichaetial leaves entire or nearly so. . . . . 1c. f. *deltonsa*.

Perichaetial leaves ciliate on the margins toward the apex. . . . . 1d. f. *leucophaea*.

Leaves, especially the uppermost, distinctly longitudinally striate. . . . . 1e. f. *striata*.

1. HEDWIGIA CILIATA [Ehrh.] Hedw. Sp. Musc. 40. 1801 (synonym).

*Anictangium ciliatum* Hedw. Sp. Musc. 40. 1801.

*Hedwigia diaphana* Beauv. Prodr. 60. 1805.

*Hedwigia integrifolia* Beauv. l. c.

*Anoetangium ciliatum* Brid. Sp. Musc. 1: 22. 1806.

*Schistidium ciliatum* Brid. Mant. Musc. 21. 1819.

*Hedwigium ciliatum* Hartm. Skand. Fl. (Ed. 5) 374. 1849.

*Pilotrichum ciliatum* C. Muell. Syn. 2: 164. 1851.

*Hedwigia albicans* Lindb. in Hartm. Skand. Fl. (Ed. 9) 2: 54. 1864.

Plants in loose, grayish green patches; stems spreading, slender, irregularly branched, bearing rhizoids at the base, 2–10 cm. long; central strand lacking; leaves imbricated, with the apices recurved when dry, papillose, spreading when moist, concave, unistratose, ovate, 1.5–3 mm. long, apex more or less hyaline, papillose-denticulate to ciliate; costa none; margins revolute; leaf cells thick walled, the upper ones oblong, lower ones elongated, those near the base quadrate; perichaetial leaves larger, ciliate at apex. Autoicous; antheridia in small, axillary buds; archegonial terminal on the main stem and branchlets, both inflorescences with numerous yellowish, filiform paraphyses; seta very short, erect, yellowish, thicker in the upper part; capsule erect, immersed, globose, or obovoid and wide-mouthed when empty, 0.5–1 mm. in diameter; calyptra small, evanescent, sub-cucullate, only covering the lid; lid broad, convex, sometimes mamillate; annulus undifferentiated, but one or two rows of exothecial cells at the mouth of the capsule smaller, reddish; peristome none; stomata in a single row; columella twisted; spores 25–32  $\mu$  in diameter, yellowish, with vermiform striations, maturing in spring.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 272, 273; Limpr. Laubm. Eur. 1, *fig.* 209; Jennings, Mosses of West Pa., *pl.* 30; Broth., Laubm. Fenn. *fig.* 71 A-E; Braithw., Brit. Moss Fl. 2, *pl.* 124E; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 22A; Roth, Eur. Laubm. 1, *pl.* 20, 35; Broth., E.-P. (Ed. 2) 11, *fig.* 481; Grout, M.H.M., *figs.* 50, 51; Sm. Eng. Bot. *pl.* 1179.

EXSICCATI.—Sull & Lesq. Musc. Bor.-Am. (Ed. 2) 224, 225, (Ed. 1) 149; Aust. Musc. Appal. 150; Holz. Musci Acro. Bor.-Am. 491, 36, 37; Macoun, Can. Musci 297, 279e; Allen, Mosses Casc. Mts. 34; Small 4, 9159, 15; Grout, N. Am. Musci Perf. 84; Best, N. Am. Mosses, April 5, 1889; Holzinger, 36, 37; R. & C. Musc. Am. Sept. 172, 290.

On various rocks throughout the world; rarely on limestone. In North America, it ranges from the Arctic regions to Mexico.

1a. forma *viridis* (Bryol. Eur.) n. comb.

*Hedwigia ciliata*, var. *viridis* Bryol. Eur. fasc. 29-30. 1846.

*Anoetangium imberbe* Drumm. Musc. Bor. Am. (Ed. 1) No. 30. 1828.

*Hedwigia albicans*, var. *viridis* Limpr. Laubm. 1: 822. 1889.

*Hedwigia ciliata*, var. *subnuda* Kindb. Mac. Cat. Can. Pl. 6: 78. 1892.

*Hedwigia albicans*, subsp. *subnuda* Paris, Index Bryol. (Ed. 2) 2: 304. 1904.

*Hedwigia albicans*, f. *viridis* Moenk. Laubm. Eur. 630. 1927.

Stems slender; leaves imbricated or spreading, bright green, scarcely at all hyaline.

On shaded rocks.

1b. forma *secunda* (Bryol. Eur.) n. comb.

*Hedwigia ciliata*, var. *secunda* Bryol. Eur., fasc. 29-30. 1846.

*Pilotrichum ciliatum*, var. *secundum* C. Muell. Syn. 2: 164. 1851.

*Hedwigia albicans*, var. *secunda* Limpr. Laubm. 1: 822. 1889.

*Hedwigia albicans*, f. *secunda* Moenk. Laubm. Eur. 630. 1927.

Leaves small, remote, more or less secund; hair point short or scarcely evident; stems elongate, slender, spreading.

On shaded rocks.

1c. forma *detonsa* (Howe) n. comb.

*Hedwigia albicans*, var. *detonsa* Howe, Erythea 5: 91. 1897.

Leaves strongly hyaline pointed; margins plane or nearly so; perichaetial leaves entire or nearly so; calyptra usually glabrous.

On rocks in California.

1d. forma *leucophaea* (Bryol. Eur.) n. comb.

*Hedwigia ciliata*, var. *leucophaea* Bryol. Eur. fasc. 29-30. 1846.

*Hedwigia albicans*, var. *leucophaea* Limpr. Laubm. 1: 822. 1889.

*Hedwigia albicans*, f. *leucophaea* Moenk. Laubm. Eur. 630. 1927.

Leaves with long, broad, hyaline points; stems robust, leafy; perichaetial leaves ciliate on the margins toward the apex.

On dry sunny rocks.

1e. forma *striata* (Wils.) n. comb.

*Anoetangium striatum* Wils. in Hook. Engl. Fl. 2: 12. 1833.

*Hedwigia ciliata*, var. *striata* Bryol. Eur. 3: (fasc. 29-30) 5. 1846.

*Pilotrichum ciliatum*, var. *striatum* C. Muell. Syn. 2: 164. 1851.

*Hedwigia albicans*, var. *striata* Paris, Index Bryol. (Ed. 2) 2: 304. 1904.

Leaves yellowish green, longitudinally striate; margins strongly recurved; lid conical.

On shaded rocks.

Subfamily 4. PTYCHOMITRIEAE.

Stems with or without a central cylinder, sometimes with regular, dichotomously arranged branches or numerous short lateral branchlets; perichaetial leaves not sheathing the base of the seta; leaves costate;

archegonial inflorescence, and later the capsule usually terminal; peristome present in all the North American species; teeth subulate or linear, 2-3-cleft to the base, or nearly to the base, not united in pairs and reflexed when dry against the wall of the capsule; capsule exserted; calyptra mitrate or campanulate.

#### 6. CAMPYLOSTELIUM Bryol. Eur. fasc. 33-36. 1846.

Small, gregarious, yellowish green mosses; stems short, simple, or branched from the base; central cylinder present; leaves crisped or curled when dry, erect-spreading when moist, linear-lanceolate, entire, bistratose on the margins; costa distinct, subpercurrent; basal cells pellucid, elongate-hexagonal; median and upper cells quadrate; perichaetial leaves undifferentiated; seta usually arcuate; capsule symmetrical, cylindrical or narrowly pyriform; annulus broad, deciduous in parts; peristome inserted on the mouth of the capsule; teeth narrow, equidistant, densely papillose, from a low basal membrane; lid with a long, straight beak; calyptra mitrate, not plicate, lobate at the base, reaching but a short distance below the lid.

A genus of four species, occurring on non-calcareous rocks in Europe and North and South America. Only one species, *C. saxicola*, is known to occur in North America.

Type species, *C. saxicola*.

#### 1. CAMPYLOSTELIUM SAXICOLA (Web. & Mohr) Bryol. Eur. 1. c.

*Dicranum saxicola* Web. & Mohr, Taschenb. 167. 1807.

*Grimmia geniculata* Schwaegr. Suppl. 1<sup>1</sup>: 82. 1811.

*Weisia geniculata* Brid. Mant. 38. 1819.

*Campylopus saxicola* Brid. l. c. 72.

*Dryptodon saxicola* Brid. Bryol. Univ. 1: 770. 1826.

*Grimmia saxicola* Hook. and Tayl. Musc. Brit. (Ed. 2) 87. 1827.

*Trichostomum saxicola* Hornsch. in Car. Linn. Syst. Veg. 4<sup>1</sup>: 171. 1827.

*Ptychomitrium geniculatum* Hampe, Flora, 20: 280. 1837.

Plants minute, gregarious, yellowish green; stems simple, or branched at the base, about 1 mm. long, somewhat radiculose below; leaves crispate when dry, erect-ascending when moist; linear-subulate, keeled; margins plane, entire; costa thick, subpercurrent, prominent on the dorsal side of the leaf; basal leaf cells elongate-rectangular to hexagonal, hyaline, median cells green and rectangular; upper cells quadrate, opaque, 6-7  $\mu$  in diameter. Autoicous; antheridial buds on short, lateral branchlets; seta arcuate, 3-5 mm. long, in the lower part twisted to the right, in the upper part twisted to the left; capsule symmetrical, cylindrical, 0.8-1 mm. long, smooth at first, becoming longitudinally sulcate in age; calyptra mitrate, reaching to just below the lid and falling with it, 5-lobate at base; operculum subulate, about as long as the capsule; stomata at the base of the capsule; annulus of 2-3 rows of cells; peristome teeth 16, filiform, often bifid and alternately longer and shorter, 0.2 mm. long, erect when dry, orange, finely and densely papillose, from a low basal membrane about 4 cells high; spores yellowish, smooth, 6-8  $\mu$  in diameter, maturing in autumn and winter.

Type locality, "im Herzogthum Braunschweig." Discovered by Schrader.

ILLUSTRATIONS.—Bryol. Eur. pl. 116; Limpr. Laubm. Eur. 1, fig. 151; Braithw. Brit. Moss Fl., 2, Pl. 53D; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 211; Roth. Eur. Laubm. 1, pl. 7; Broth., E.-P. (Ed. 2) 11, fig. 425; Schwaegr. Suppl. 1<sup>1</sup>, pl. 22; Hook. & Tayl. Musc. Brit. (Ed. 2) pl. 13; Engl. Bot. Suppl. 1830. 5, Pl. 2627; Pl. 15D.

EXSICCATI.—On sandstone boulders, Hunter's River, Prince Edward Island, Canada, Macoun, in 1888; on sandstone boulders near Closter, New Jersey, rare, Aust. Musc. Appal. 109.

On moist, shaded, non-calcareous rocks principally sandstone, Prince Edward Island, New Jersey, Massachusetts, Kentucky. Europe.

#### 7. PTYCHOMITRIUM Förmr. Flora, 2: 19. 1829.

Plants loosely pulvinate; stems erect or spreading, simple or branched; central cylinder present; leaves muticous, crisped when dry, entire or toothed, lanceolate or lingulate; costa single; leaf cells smooth walled, upper and median cells small and roundish-quadrate, those at the base of the leaf linear or rectangular; perichaetial leaves not sheathing the base of the seta. Autoicous; antheridial buds below the archegonia; seta erect, straight, often more than one from the same perichaetium; capsule ovoid to ellipsoid; annulus

broad, revoluble, rarely lacking; peristome inserted below the mouth of the capsule, teeth linear, usually 2-cleft to the base or nearly to the base into filiform, papillose divisions; lid usually with a long, straight beak; calyptra campanulate-mitrate, plicate, glabrous, lobate at the base, reaching to the middle of the capsule; spores small.

A genus of over sixty species, occurring on non-calcareous rocks, rarely on tree trunks. In North America north of Mexico, five species are known to occur at the present time. A fossil species, *P. Cockrelleae* (E. G. Britt. & Hollick) Broth., has been collected in Colorado.\* †

Leaves entire or nearly so.

Peristome teeth separate to the base; leaves 1.3–1.7 mm. long; seta 2 mm. long;  
capsule 0.5–0.75 mm. long. . . . . 1. *P. incurvum*.

Peristome teeth joined at the base; leaves 3.5–5 mm. long; seta about 5 mm. long;  
capsule 1.2–1.4 mm. long. . . . . 2. *P. Leiberghii*.

Leaves serrate in the upper half.

Peristome teeth separate to the base; leaves 4–6 mm. long; setae 1–2 cm. long. . . . 3. *P. Gardneri*.

Peristome teeth 2–3-cleft above the middle; leaves 1–1.5 mm. long; seta 2–3 mm.  
long. . . . . 4. *P. Drummondii*.

#### 1. *PTYCHOMITRIUM INCURVUM* (Muhlenb.) Sull. Mosses of U. S. 35. 1856.

*Grimmia incurva* Muehlenb. Cat. Pl. Am. Sept. 78. 1813.

*Weisia incurva* Schwaegr. Suppl. 2<sup>1</sup>: 51. 1823.

*Grimmia Hookeri* Drumm. Musci Am. Bor. (Ed. 1) No. 61.

*Grimmia Muehlenbergii* Brid. Bryol. Univ. 1: 181. 1826.

*Notarisia virginica* Hampe, Linnaea 380. 1837.

*Ptychomitrium pygmaeum* Lesq. & James, Proc. Am. Acad. (N. S.) 6: 136. 1879, and Man. 157. 1884.

*Brachysteleum pygmaeum* Kindb. Eur. & N. Am. Bryin. 243. 1897.

Plants in small, irregular tufts, 5–7 mm. high, brownish green or blackish green; stems erect or ascending, simple, or sometimes with short branchlets; central cylinder of the stem small; leaves crowded, crisped when dry, slightly incurved when moist, the lower ones smaller, upper leaves 1.3–1.7 mm. long, linear from a lanceolate base, not plicate, obtuse to almost cucullate at the apex, entire, concave and bistratose in the upper half; margins plane; costa broad, percurrent or subpercurrent; leaf cells smooth, thick-walled, the upper roundish-quadrate, roundish, or broadly oval, 7–9  $\mu$  in diameter, median and basal cells quadrate or rectangular, more or less hyaline. Autoicous; antheridial buds axillary or cladogenous, at the base of the vaginule; perichaetial leaves scarcely differentiated; seta yellowish green, about 2 mm. long, erect, twisted to the right; capsule erect, ovoid, 0.5–0.75 mm. long, smooth; calyptra mitrate, reaching to below the middle of the capsule; lid subulate, almost as long as the capsule; annulus broad, revoluble; stomata in one row; peristome 0.2 mm. long, the teeth 16, in pairs, separate to the base, linear, scarcely wider below, entire, densely papillose, with the distant articulations slightly swollen; spores yellowish brown, slightly granulose, 10–12  $\mu$  in diameter, maturing in spring.

Type locality, on exposed rocks, eastern New York.

ILLUSTRATIONS.—Sull. Icones, pl. 39; Schwaegr. Suppl. 2<sup>1</sup>, pl. 116. M. H. M. f. 52.

EXSICCATI.—Drumm. Musc. Am. 61 (as *Grimmia Hookeri*), S. States 28, 29 (as *G. Muehlenbergii*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 130, (Ed. 2) 195; Sull. Musc. Allegh. 135 (as *P. pusillum*); Aust. Musc. Appal. 153; Holz. Musci Acro. Bor.-Am. 266; Small, 25; Pigeon Gap, North Carolina, Grout 7/11/07; New Dorp, New York, Grout, November 11, 1888; Glenolden, Pennsylvania, A. F. K. Krout.

On exposed siliceous rocks, especially sandstone, New York to Ontario and south to Texas. Very common in southern Ohio, according to the Lesquereaux & James Manual. This species is very similar to the European *P. glyphomitrioides* (Bals. & DeNot.) Vent. & Bott. but the peristome teeth of that species are lanceolate-deltoid at the base and are divided from below the middle into two unequal, filiform branches. Also the capsule is slightly longer, with a more sharply beaked lid.

#### 2. *PTYCHOMITRIUM LEIBERGHII* Best, Bryologist 9: 80. 1906.

Plants in loose tufts, about 1 cm. high, olive green above, brownish below; stems erect, with a small distinct central cylinder; leaves thickish, crispate when dry, erect-spreading when moist, somewhat un-

\*Brotherus, V. F., Musci, E.-P., (Ed. 2) 11: 523. 1925.

†See p. 60.

dulate, entire, 3.5–5 mm. long, linear-lanceolate from a concave suboval base, acute or obtusish at apex; margins plane; costa thick, reddish, slightly subpercurrent; leaf cells uniform in size and arrangement, mostly unistratose, or bistratose in rows in the upper part of the lamina and on the margins; upper cells roundish-quadrate, 9–11  $\mu$  in diameter, basal cells rectangular, or quadrate, more or less hyaline. Autoicous; antheridial buds stipitate, at the base of the setae; perichaetial leaves like the stem leaves but larger; *setae* reddish, about 5 mm. long; capsules erect, ovoid-ellipsoid, 1.2–1.4 mm. long, wrinkled when dry; annulus broad, of 3 rows of cells, deciduous in fragments; peristome teeth 16, in pairs, joined at the base; linear-lanceolate, broader at the base, coarsely papillose and articulated, more or less cleft or nearly entire; lid with a beak about 1 mm. long; calyptra campanulate-mitrate, deeply lobed, plicate, roughened at the apex; spores granulose, 13–16  $\mu$  in diameter, maturing in spring.

Type locality, on rocks, near the south end of Baboquivara Range, Arizona, collected by John B. Leiberg in February, 1906.

ILLUSTRATIONS.—Bryologist 9, pl. 7; Pl. 20.

EXSICCATI.—Arizona, Leiberg, February, 1906; rock crevices, Santa Catalina Mts., Pima Co., Arizona, Altitude 2,500 feet, February 2, 1923, Bartram 515.

This species is perhaps more closely related to *P. Gardneri* than to any other American member of the genus. From *P. Gardneri* it differs in its smaller size, the entire leaves which are somewhat undulate but not plicate, and by the peristome teeth being more or less cleft or nearly entire, but not divided to the base into filiform divisions.

### 3. PTYCHOMITRIUM GARDNERI Lesq. Mem. Cal. Acad. 1: 16. 1868.

*Brachysteleum Gardneri* Kindb. Eur. and N. Am. Bryin. 242. 1897.

Plants in loose, roundish, dark green tufts; stems robust, 3–4 cm. long, erect, or ascending, leafy, blackish and often with some rhizoids at the base; central cylinder present; leaves crowded, crisped when dry, erect-spreading or erect when moist, 4–6 mm. long, acuminate, lanceolate, plicate at base, margins recurved in the lower part of the leaf, incurved or erect in the upper part and sharply serrate near the apex; leaves unistratose, or from the base to the median part of the lamina bistratose in one or two rows; costa percurrent, prominent on the dorsal side of the leaf; leaf cells yellowish, incrassate, not papillose, the upper ones opaque, roundish-quadrate, 8–10  $\mu$  in diameter; median cells rectangular, basal cells linear; perichaetial leaves undifferentiated. Autoicous; antheridial buds usually 2–4 at the base of the vaginule within the perichaetium, rarely are they axillary; setae often several from the same perichaetium, 1–2 cm. long, straight, reddish below, twisted to the right, in the upper part yellowish and twisted to the left; capsule erect, ellipsoid, brownish, smooth at first, becoming sulcate when empty; calyptra campanulate-mitrate, extending to below the lid, longitudinally plicate, glabrous, smooth; lid subulate, half the length of the capsule, persistent; annulus broad, of 3–4 rows of cells, revolute; stomata in one row at the base of the capsule; peristome about 1 mm. long, teeth bifid to near the base into 2–3, reddish, linear or filiform, papillose divisions; articulations obscure; spores brownish, smooth, 11–13  $\mu$  in diameter, maturing in spring.

Type locality, Dardanelles Canyon, Forest Hill, California, collected by H. N. Bolander.

ILLUSTRATIONS.—Pl. 25.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 211; Leiberg 161; Bolander 8; Henderson 12088; R. & C. Musc. Am. Sept. 35.

On rocks, British Columbia to California. This species is very closely allied to the European *P. polyphyllum* Fuernr, which is however, unknown in North America. *P. polyphyllum* is a smaller plant, with longer and narrower leaves. The peristome teeth of that species are bifid and the annulus is broader.

### 4. PTYCHOMITRIUM DRUMMONDII Sull. Mosses U. S. 36. 1856.

*Grimmia Drummondii* Hook. f. & Wils. Journ. Bot. 3: 90. 1841.

*Brachysteleum Drummondii* C. Muell. Syn. 1: 770. 1849.

Plants closely tufted; stems erect or spreading; central cylinder present; leaves spreading or reflexed when moist, crisped when dry, lanceolate, 1–1.5 mm. long, muticous, acute; margins denticulate-serrate in the upper half; autoicous; seta 2–3 mm. long; peristome attached below the mouth of the peristome, teeth 16, linear, in pairs, closely trabeculate, split at the apex into 2–3 short, papillose segments; lid with a long straight beak; annulus none; calyptra campanulate-mitrate, plicate, glabrous, lobate at the base, reaching to the middle of the capsule; spores small, in spring.

Type locality, "on trees, Southern States, near the coast."

On tree trunks, Tennessee to the Gulf of Mexico.

ILLUSTRATIONS.—Sull. Icones, *pl.* 40; Journ. Bot. 3, *pl.* 3 & 4, 25 B; *Pl.* 20.

EXSICCATI.—Atlanta, Texas, F. McAllister, December, 1926; Augusta, Georgia, Small 30; Conroe, Texas, F. McAllister, September 2, 1929; Thomasville, Ga., May 16 (year and collector not given). Drum. Musc. Am. S. States 30; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 196; R. & C. Musc. Am. Sept. 36; Grout, Musci Perfecti 203.

### 8. RHACOMITRIUM Brid. Mant. 78. 1819.

Robust, mostly rupestral plants, usually loosely and widely cespitose, yellowish or blackish green; stems spreading, bearing rhizoids only at the base, leafy throughout, often with numerous short lateral branchlets; central cylinder absent; leaves numerous, imbricated when dry, mostly lanceolate, acuminate or obtuse, often with hyaline hair points consisting of linear, non-chlorophyllous cells; costa complete, usually broad and flat, homogeneous, single, usually percurrent or slightly subpercurrent; leaf margins sometimes bistratose, or revolute, usually entire, except on the terminal hyaline portion, occasionally denticulate; leaf cells sometimes papillose, usually more or less incrassate, the upper ones mostly small and roundish-quadrate or somewhat elongated, the basal cells linear or rectangular, usually nodulose or sinuose, seldom entire. Dioicous; antheridia and archegonia terminal on the stem and on the short lateral branchlets; seta long, straight or arcuate, usually twisted to the right\* (with the exception of three species); sheath usually cylindrical; capsule erect, exerted, ovoid to ellipsoid or cylindrical, narrow-mouthed, smooth; stomata present at the base of the capsule; annulus present; calyptra non-plicate, mitrate, often papillose at the apex, usually long beaked; lid conical, long beaked; peristome present, single; teeth 16, united at the base, but deeply cleft into 2-3 linear divisions, trabeculate; basal membrane not extending beyond the annulus; spores 0.8-35  $\mu$  in diameter.

A genus of about eighty species, distributed throughout the world, nine of which are known to occur in North America. The European *R. ellipticum* Bry. Eur. is as yet unknown on this continent.

Rhacomitrium is evidently related to Grimmia through the subgenus Dryptodon. Its most distinctive generic characters which separate it from Grimmia are the peculiar basal areolation of the lower third of the lamina, the deeply cleft peristome, and the subulate operculum. C. Mueller, Lindberg, and Braithwaite united both genera under Grimmia, but they appear to be amply distinct.

All the species of Rhacomitrium are dioicous, the central strand of the stem is undifferentiated, the leaves are usually non-crispate when dry, the basal leaf cells are usually linear with sinuose or nodulose walls, and the spores vary from 8  $\mu$  in diameter in *R. canescens* and *R. lanuginosum*, to 35  $\mu$  in *R. ellipticum*. Most of the species are rupestral.

#### A. Leaf cells smooth or only finely papillose (except *R. aquaticum*); rupestral species.

##### a. Leaves muticous.

Costa 2-4-ridged on the back; leaves lanceolate, acuminate, entire or nearly so, strongly recurved when moist; upper cells small, roundish; seta twisted to the left; calyptra smooth; peristome teeth 0.2-0.3 mm. long.....

1. *R. patens*.

Costa terete on back; calyptra papillose at apex.

Upper green leaf cells predominantly isodiametrical or nearly so.

Apex of leaf broad, rounded, usually dentate; peristome teeth 0.6-0.8 mm. long.....

2. *R. aciculare*.

Apex of leaf obtuse, not dentate; peristome teeth 0.2-0.4 mm. long.

Leaves entire; cells not papillose.

Leaf margin 1 cell thick throughout; short tuft-like lateral branchlets none or few.....

3. *R. depressum*.

Leaf margin more than 1 cell thick above.

Short lateral branchlets many; plants short, densely pulvinate.....

7a. var. *affine*, f. *obtusum*.

\*i. e., clock-wise.

- Short lateral branchlets few or none; plants slender, with elongated stems. . . . . 7b. *R. heterostichum*, var. *gracilescens*.
- Leaves minutely crenulate-papillate at apex; short, tuft-like lateral branchlets none; leaf cells papillose. . . . . 4. *R. aquaticum*.
- Upper green leaf cells predominantly elongate, or sometimes a few isodiametrical cells at the tip.
- Leaves acutish; short, tuft-like lateral branchlets many; cells finely papillose; capsule 2-2.5 mm. long; peristome teeth 0.5-0.7 mm. long; plants slender. . . . . 6. *R. fasciculare*.
- Leaves obtuse; cells scarcely papillose; capsule 3-4 mm. long; plants robust; peristome teeth 1.5-1.7 mm. long. . . . . 5. *R. varium*.
- aa. Leaves, at least some of those at the tips of the branches, with hyaline points.
- b. Hyaline points toothed but not papillose or ciliate; seta smooth, twisted to the right; spores 12-18  $\mu$  in diameter, finely granular. Upper green leaf cells predominantly isodiametrical.
- Short lateral branchlets numerous; apical cells nearly isodiametrical, becoming gradually longer towards the middle of the leaf; capsule ellipsoidal or cylindrical, 2-3 mm. long; seta 5-8 mm. long.
- Leaf margins unistratose throughout; plants grayish green, in depressed, rather short-stemmed, close tufts. . . . . 7. *R. heterostichum*.
- Leaf margins more than 1 cell thick near apex; plants yellowish green; stems slender, elongated, trailing. . . . . 7a. *R. heterostichum*, var. *affine*.
- Short lateral branchlets absent; upper cells isodiametrical to the middle of the leaf; leaves 2-3-stratose on the margins, at least in the upper half of the leaf; seta 2-5 mm. long; capsule ovoid or ellipsoid, 1-1.8 mm. long.
- Hyaline points acute; leaves not twisted or curled when dry; capsule ovoid; plants in wide, loose yellowish green patches; branches ascending. . . . . 7c. *R. heterostichum*, var. *sudeticum*.
- Hyaline points short, blunt, few; capsule ellipsoid; leaves somewhat twisted or curled when dry; plants in loose, brownish green tufts, the tips of the branches green. . . . . 7d. *R. heterostichum*, var. *Macounii*.
- Upper green leaf cells predominantly elongate.
- Capsule 3-4 mm. long; peristome teeth 1.5 mm. or more in length; seta 10-15 mm. long; plants rather coarse, robust, with few or no short lateral branchlets. . . . . 5. *R. varium*.
- Capsule 1.5-2 mm. long; peristome teeth 0.5 mm. long; seta 4-5 mm. long; plants slender with numerous short, tuft-like, lateral branchlets. . . . . 7e. *R. heterostichum*, var. *ramulosum*.
- bb. Hyaline leaf points papillose and ciliate; seta papillose at the base, twisted to the left; upper leaf cells elongate; spores 8-12  $\mu$  in diameter, smooth. . . . . 9. *R. lanuginosum*.
- B. Leaf cells and hyaline leaf points strongly and distinctly papillose on both surfaces; terrestrial or rupestral species; seta smooth, twisted to the left; upper leaf cells isodiametrical; spores smooth, 8-10  $\mu$  in diameter; peristome teeth 1.3-1.6 mm. long.
- Leaves hyaline pointed.

- Short tuft-like lateral branchlets few or none..... 8. *R. canescens*.  
 Short tuft-like lateral branchlets very numerous..... 8a. *f. ericoides*.  
 Leaves mucous or nearly so..... 8b. *f. epilosum*.

## Subgenus 1. DRYPTODON.

Stems dichotomously branched; lateral branchlets none; leaves obtuse, non-piliferous; upper leaf cells isodiametrical; peristome teeth bifid to the middle or below.

## 1. RHACOMITRIUM PATENS (Hedw.) Huebn. Musc. Germ. 198. 1833.

- Pterigynandrum* (?) *patens* Hedw. Sp. Musc. 86. 1801.  
*Dicranum patens* Sm. Fl. Brit. 1212. 1804.  
*Dicranum arcuatum* Schleich. Cat. 1807.  
*Trichostomum patens* Web. & Mohr, Bot. Taschb. 125. 1807.  
*Fissidens patens* Wahlenb. Fl. Lapp. 334. 1812.  
*Campylopus patens* Brid. Bryol. Univ. 1: 192. 1826.  
*Orthotrichum* (?) *curvatum* Brid. l. c. 791.  
*Grimmia arcuata* De Not. Mem. Acc. Torin. 38: 250. 1836.  
*Grimmia patens* Bryol. Eur. 3: (fasc. 25-28) 18. 1845.

Plants in loose, flat, fragile, dark green tufts; stems without central cylinder, spreading, 5-12 cm. long, leafy, forked, with a few elongated branches, leafless and with some rhizoids at the base; short, tuft-like lateral branchlets few or none; leaves imbricated and slightly crispate when dry, strongly recurved when moist, lanceolate, 2-3 mm. long, acuminate, *mucous*, keeled above; margins revolute at base, 2-3-stratose near the apex; *costa stout, canaliculate and 2-4-ridged on the dorsal side of the leaf*; leaf cells strongly sinuose, convex; median cells roundish-quadrate, 8-9  $\mu$  in diameter, basal cells linear, or those toward the margins in the basal angles of the leaf rectangular or quadrate. Dioicous; seta arcuate, twisted to the left, yellowish, 3-5 mm. long; capsule 1.5-2 mm. long, cernuous or horizontal, becoming erect, ovoid, pale brown, smooth, or when dry somewhat sulcate; *calyptra smooth*, mitrate, extending to the base of the lid, or sometimes almost cucullate; lid about one-third the length of the capsule, long beaked, usually falling with the calyptra; annulus of 3 rows of large cells, revolute; cells of the exothecium thin walled, oblong or hexagonal with 3 rows near the mouth of the capsule smaller, roundish; stomata in one row; columella thick, becoming twisted; peristome teeth united at the base, 2-cleft to below the middle into linear divisions, reddish, densely papillose, 0.2-0.3 mm. long; preperistome none; spores 12-16  $\mu$  in diameter, olive green, finely granulose.

Type locality, "Ad rupes in rivulis alpinis Scotiae. Ben Nevis."

ILLUSTRATIONS.—Bryol. Eur. *pl.* 246; Limpr. Laubm. Eur. 1, *fig.* 205; Braithw. Brit. Moss Fl., 2, *pl.* 51 A; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 19 E; Roth, Eur. Laubm. 1, *pl.* 29, 34; Loeske, Laubm. Eur. 1913, *figs.* 23h, 49, 50; Frye, Bryologist 20, *pl.* 20; *Pl.* 24.

EXSICCATI.—Macoun, Can. Musci 278, 280, 96; Holz. Musci Acro. Bor.-Am. 187; Sandberg and Leiberg 855; Leiberg 230; Kienholz 216; Grant 8120.

On alpine and subalpine rocks, frequently sterile; spores maturing in spring. Greenland to Alaska, British Columbia, Washington, Oregon, Idaho, and Montana. Europe.

There is a considerable divergence of opinion about the relationship of this species. Bruch, Schimper & Guembel, the authors of the Bryologia Europaea, assumed that it has a close connection with *Grimmia*, and they disposed of it accordingly in that genus. Dixon, in his Student's Handbook of British Mosses, follows the same plan. Hagen, Brotherus and Loeske have come to a similar conclusion, while Schimper, Moenkemeyer, Frye, and others favor *Rhacomitrium*. Limpricht put this species in the genus *Dryptodon*, following Bridel of 1826. It is evident that it is an anomalous species, an intermediate between *Grimmia* and *Rhacomitrium*. The basal leaf cells are not nodulose the whole width of the leaf as is the general rule in *Rhacomitrium*. However, the habit, and, what is more important, the peristome, place it nearer to *Rhacomitrium*. In habit, it bears some resemblance to *R. aquaticum*. The lamellate or ridged condition of the costa on the dorsal side of the leaf readily distinguishes it from any other species of the genus. Whether it has evolved from some *Grimmia*-like prototype, or whether its origin is otherwise, it is probable, in view of the lack of connecting species, that it became segregated at an early stage in the evolution of the family.

## 2. RHACOMITRIUM ACICULARE Brid. Mant. 80. 1819.

- Trichostomum aciculare* Beauv. Prodr. 90. 1805.  
*Trichostomum obtusifolium* Beauv. l. c. 91.

*Rhacomitrium obtusifolium* Brid. l. c.

*Trichostomum aciculare*  $\alpha$  *obtusifolium* W. Arn. Mém. soc. d'hist. nat. Paris 3: 245. 1825.

*Campylopus acicularis* Wahlenb. Fl. Suec. 2: 749. 1826.

*Grimmia acicularis* C. Muell. Syn. 1: 801. 1849.

*Grimmia Nevii* C. Muell. Flora 483. 1873.

*Rhacomitrium Nevii* S. Wats. Bot. Calif. 2: 381. 1880.

*Rhacomitrium aciculare Nevii* Frye, Bryologist 20: 95. 1917.

Plants rather coarse, in loose, dull dark green tufts; stems stout, without central cylinder, leafy, 3–10 cm. long; dichotomously branched, leafless at base; short, tuft-like, lateral branchlets none; leaves muticous, crowded, imbricated when dry, erect-spreading when moist, broadly lanceolate or lingulate, concave, *obtus* and *dentate* (sometimes entire) at apex, unistratose, both margins unistratose throughout, and revolute in the lower half of the leaf; costa narrow, *terete*, slightly subpercurrent; cells sinuose, indistinctly papillose, the upper ones isodiametrical; median cells rectangular, those at the base of the leaf linear, nodulose; inner perichaetial leaves with the costa more or less indistinct. Dioicous; seta erect, straight, 5–15 mm. long, dark brown, twisted to the right; capsule erect, ellipsoid to almost cylindrical, 2–2.5 mm. long, brown; calyptra mitrate, papillose at apex; lid with a subulate beak  $\frac{1}{2}$ – $\frac{2}{3}$  as long as the capsule; annulus of 3–4 rows of reddish, elliptical cells, deciduous; exothecial cells thick walled, the upper ones mostly rectangular, the lower quadrate, with the stomata in 3 or 4 rows; peristome teeth papillose, 0.6–0.8 mm. long, cleft nearly to the base into 2–3 unequal, linear-subulate divisions; spores 14–20  $\mu$  in diameter, yellowish, finely granular, in spring.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. pl. 262; Jennings, Mosses of W. Pa. pl. 14; Braithw. Brit. Moss Fl. 2, pl. 51 c; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 20 I; Roth Eur. Laubm. 1, pl. 29, 34; Grout, M.H.M. pl. 21; Loeske, Laubm. Eur. 1913, figs. 61 a, 62 a, 63 a, 65, 66; Frye, Bryologist 20, pl. 21.

EXSICCATI.—Drumm. Musc. Am. 133; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 143, (Ed. 2) 217; Austin, Musc. Appal. 147; Macoun, Can. Musci 279, 97; Holz. Musci Acro. Bor.-Am. 238; Grout, N. Am. Musci Perfecti 90; Allen, Mosses Casc. Mts. 30.

On wet, shaded, noncalcareous rocks in alpine or sub-alpine regions, usually in and along streams, Alaska and Yukon to California and Montana; Labrador and Nova Scotia to Alabama. Europe. Africa.

### 3. RHACOMITRIUM DEPRESSUM Lesq. Mem. Calif. Acad. Sci. 1: 14. 1868.

Plants in low, yellowish green or blackish green tufts; stems 10–15 cm. long, with few or no elongated branches; short tuft-like lateral branches none or few; leaves loosely imbricated when dry, erect when moist, obtuse, ovate-lanceolate, entire or nearly so, smooth, unistratose throughout; costa subpercurrent; upper leaf cells isodiametrical or nearly so; median cells elongated, basal cells linear, all sinuose or nodulose. Dioicous; calyptra mitrate; seta 6–8 mm. long, twisted to the right; capsule erect, cylindrical, 2.2–2.5 mm. long; peristome teeth 0.2–0.4 mm. long, usually 3-cleft into smooth, unequal divisions.

Type locality, "falls of the Yosemite Valley," California, collected by H. N. Bolander.

ILLUSTRATIONS.—Frye, Bryologist 20, pl. 23; Pl. 22.

EXSICCATI.—Macoun, Can. Musci 281 (620); Holz. Musci Acro. Bor.-Am. 620.

On rocks, British Columbia and California; Labrador. Similar to *R. aquaticum*, but that species has the capsules less than 2 mm. long, and the leaf-cells have paired papillae over the cell walls.

### 4. RHACOMITRIUM AQUATICUM Brid. Bryol. Univ. 1: 222. 1826 (excl. syn.).

*Dicranum aciculare* var.  $\gamma$  *gracile* Turn. Musc. Hib. 67. 1804.

*Trichostomum fascicular*  $\beta$  *secundum* Ahnf. in Fries, Stirp. 28. 1825.

*Trichostomum aciculare*  $\beta$  *acutifolium* W. Arn. Mém. soc. d'hist. nat. 3: 245. 1825.

*Racomitrium cataractarum* A. Br. in Brid. op. cit. 776.

*Trichostomum obtusum* Schultz, Syllog. Ratisb. 2: 144. 1828.

*Trichostomum fasciculare*  $\beta$  *protensum* Hartm. Skand. Fl. (Ed. 2) 321. 1832.

*Racomitrium protensum* A. Br. in Hueben. Musc. Germ. 211. 1833.

*Trichostomum cataractarum* Hartm. Skand. Fl. (Ed. 3) 283. 1838.

*Rhacomitrium aciculare*\* *aquaticum* Ångstr. Disp. Musc. Scand. 15. 1842.

*Grimmia aquatica* C. Muell. Syn. 1: 800. 1849.

Plants in loose yellowish green tufts; stems spreading, branched, 5–10 cm. long; *short tuft-like lateral branchlets none*; leaves crowded, imbricated when dry, erect-spreading when moist, linear-lanceolate, 2–3 mm. long, unistratose, obtuse, *minutely crenulate-papillate at apex*, mucous, concave; margins unistratose, revolute; costa distinct, broad, reddish green, subpercurrent, 2–4-stratose; cells sinuose, *strongly papillose*, with roundish, bifurcate papillae; upper and median cells rectangular or elliptical, those at the base of the leaf linear, nodulose. Dioicous; seta straight, 5–8(–13) mm. long, yellowish or brownish, twisted to the right; capsule erect, ellipsoidal or cylindrical, 1.5–2 mm. long, smooth, pale brown; calyptra mitrate, papillose at apex; lid subulate-beaked; annulus of 2–4 rows of cells, persistent; stomata usually in 2 rows; peristome teeth finely papillose, 2-cleft to near the base into linear-subulate, unequal, finely papillose, distinct divisions; spores yellowish brown, granular, 14–18  $\mu$  in diameter.

Type locality, European.

On moist rocks, Greenland; Europe; Africa; Australasia. Not yet known to occur on continental North America.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 263; Braithw. Brit. Moss Fl. 2, *pl.* 51 B; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 20 J; Roth, Eur. Laubm. 1, *pl.* 34; Loeske, Laubm. Eur. 1913, *figs.* 62 b, 63 b; *Pl.* 11.

#### Sugbenus 2. EURHACOMITRIUM.

Stems fasciculately branched, often with numerous short lateral branchlets; leaves usually piliferous; peristome teeth deeply 2-cleft into linear or filiform divisions.

#### 5. RHACOMITRIUM VARIUM (Mitt.) Lesq. & James Man. Mosses N. Am. 150. 1884.

*Grimmia varia* Mitt. Journ. Linn. Soc. 8: 21. 1865.

*Rhacomitrium canescens*, var. *lutescens* Lesq. & James, l. c. 151.

*Rhacomitrium oreganum* Ren. & Card. Bot. Gaz. 13: 198. 1888.

*Grimmia speciosa* C. Muell. Bot. Centralbl. No. 5, 1890.

*Rhacomitrium speciosum* Ren. & Card. Obs. Musci Amer. Sept. 25. 1893.

Plants rather coarse, robust, in spreading, yellowish green tufts; stems prostrate, nearly leafless below; with few or no elongated branches; short tuft-like lateral branches often present; leaves appressed when dry, erect-spreading when moist, lanceolate, obtuse, carinate, mucous or the upper ones with a short, somewhat denticulate hyaline point; margins unistratose, revolute; leaf cells elongate, slightly papillose, sinuose, a marginal row of apical cells isodiametrical. Dioicous; seta smooth, twisted to the right, 10–15 mm. long; capsule erect, smooth, cylindrical 3–4 mm. long, somewhat plicate when old and empty; calyptra cuculate, acuminate; lid subulate, nearly as long as the capsule; annulus of 3 rows of cells; *peristome teeth 1.5–1.7 mm. long*, faintly papillose or nearly smooth, reddish, divided to the base into 2, filiform, often unequal divisions; spores 12–18  $\mu$  in diameter.

Type locality, "British Columbia, Lyall and Douglas; and also in Observatory Inlet."

On rocks, or rarely on the ground or on logs, usually in woods, Alaska to California. A distinctive character of this species is that the capsule is longer than that of any other North American species of the genus.

ILLUSTRATIONS.—Bot. Gaz. 13, *pl.* 15; Bryologist 21, *pl.* 7; *Pl.* 23.

EXSICCATI.—Macoun, Can. Musci 290; Baker, Pac. Slope Bry. 589; Holz, Musci Acro. Bor.-Am. 419; Allen, Mosses Casc. Mts. 31; Henderson 1227, 11880, 12064; R. & C. Musc. Am. Sept. 29.

#### 6. RHACOMITRIUM FASCICULARE (Hedw.) Brid. Musc. Recent. Suppl. 4: 80. 1819.

*Trichostomum fasciculare* Hedw. Sp. Musc. 110. 1801.

*Bryum lutescens* Dicks. Fasc. Pl. Crypt. 4: 14. 1801.

*Trichostomum ? lutescens* Beauv. Prodr. 91. 1805.

*Trichostomum maritimum* Blytt, Hartm. Skand. Fl. (Ed. 3) 283. 1838.

*Grimmia fascicularis* C. Muell. Syn. 1: 809. 1849.

*Racomitrium virescens* Lindb. Acta Soc. Sci. Fenn. 10: 68. 1871.

*Rhacomitrium microcarpum*, var. *Palmeri* Kindb. in Macoun Cat. Can. Pl. 6: 267. 1892.

*Rhacomitrium Palmeri* Kindb. Rev. Bryol. 19. 1896.

*Rhacomitrium tenuinerve* Kindb. Rev. Bryol. l. c.

Plants yellowish green or brownish; stems 8–12 cm. long, slender, often with a few elongated branches; short, tuft-like, lateral branchlets numerous; leaves loosely imbricated when dry, erect-spreading when moist, narrowly lanceolate, acutish, muticous, 2–3 mm. long; margins revolute, unistratose; costa flat, bistratose, subpercurrent; leaf cells strongly sinuose or nodulose, finely papillose, the upper 3–4 : 1. Dioicous; seta 4–12 mm. long, straight; capsule erect, ellipsoidal, 2–2.5 mm. long, narrow-mouthed smooth, brown; calyptra mitrate, papillose throughout; lid long-beaked; annulus of 2–3 rows of large cells, revolvable; stomata in one row; peristome teeth united at the base, 0.5–0.7 mm. long, reddish, 2-cleft into filiform, papillose divisions; spores yellowish, 12–16  $\mu$  in diameter, in spring.

Type locality, "in Harze (Brocken, Achtermann-Shoehe)" (Germany), discovered by Schrader.

On moist alpine and subalpine rocks, seldom at sea level, Alaska to Labrador and Greenland, south to Washington and New York. Europe. Asia.

ILLUSTRATIONS.—Bryol. Eur. pl. 267; Braithw. Brit. Moss Fl. 2, pl. 52 B; Dixon, Handb. Brit. Mosses, (Ed. 3) pl. 20 K; Roth, Eur. Laubm. 1, pl. 34; Grout, M.H.M. pl. 22; Loeske, Laubm. Eur. 1913, figs. 23 i, 59, 62 c, 63 d; Frye, Bryologist 21, pl. 14.

EXSICCATI.—Drumm. Musc. Am. 132 (as *Trichostomum*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 146, (Ed. 2) 220; Macoun, Can. Musci 289, 100 a; Holz. Musci Acro. Bor.-Am. 447; Grout, N. Am. Musci Perf. 106; Piper 241, 244; Sandberg and Leiber 863; Aust. Musc. Appal. Suppl. 502; Sull. Musc. Allegh. 132.

#### 7. RHACOMITRIUM HETEROSTICHUM (Hedw.) Brid. Musc. Recent. Suppl. 4: 79. 1819.

*Trichostomum heterostichum* Hedw. Sp. Musc. 109. 1801.

*Dryplodon carnosus* Brid. Bryol. Univ. 206. 1826.

*Trichostomum carnosum* Dicks.; Brid. l. c.

*Trichostomum stenocarpum* Hampe, in Hueben. Musc. Germ. 208. 1833.

*Grimmia heterosticha* C. Muell. Syn. 1: 807. 1849.

*Racomitrium heterostichum*, subsp. *vulgare* Loeske, Laub. Eur. 1: 183. 1913.

Plants in close, roundish, depressed, often grayish green tufts; stems 2–6 cm. long, erect or spreading, usually with many short, tuft-like, lateral branchlets; leaves loosely imbricated when dry, recurved and erect-spreading when moist, lanceolate, 2–2.5 mm. long, keeled, acuminate, nearly smooth; hyaline points smooth; margins revolute, unistratose throughout; costa flat, 2–3-stratose; cells sinuose, upper ones isodiametrical, 7–9  $\mu$  in diameter, becoming gradually longer toward the middle of the leaf; median cells rectangular, basal cells linear, orange colored. Dioicous; seta straight or sometimes somewhat arcuate, smooth, 5–8 mm. long, twisted to the right; capsule erect, cylindrical or ellipsoidal, 2–3 mm. long, smooth, brown, narrowed at the mouth; calyptra mitrate, papillose at apex; lid linear-subulate; annulus of 2–3 rows of reddish cells, deciduous; stomata in 2–3 rows; peristome teeth united at the base, 0.2–0.4 mm. long, densely papillose, cleft to the base into 2, filiform, unequal divisions; spores finely granular, 10–18  $\mu$  in diameter.

ILLUSTRATIONS.—Bryol. Eur. pl. 265; Broth. Laubm. Fenn. fig. 35 A–F; Braithw. Brit. Moss Fl. 2, pl. 52 A; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 21 A; Roth, Eur. Laubm. pl. 34; Loeske, Laubm. Eur. 1913, figs. 56 d, 59; Frye, Bryologist 21, pl. 2; Pl. 22.

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 496, 159; Macoun, Can. Musci 99; Grout, N. Am. Musci Perfecti 102; Henderson 12160, 12091, 12085, 12162; Allen, Mosses Casc. Mts. 33; Leiber 192.

On rocks in mountainous regions, Alaska to Greenland and Labrador, south to California. Europe. Asia. Australasia. In the United States it is apparently a rare species east of the Mississippi River. With the possible exception of *Grimmia apocarpa* and *G. trichophylla*, it is the most variable species in the Grimmiaceae.

#### 7a. Var. AFFINE (Schleich.) C. Jens. Danmarks Mossor 2: 238. 1923.

*Trichostomum affine* Schleich. Cat. (Ed. 2) 31. 1807.

*Trichostomum alopecurum* Schkuhr, Deutschl. Moose 77. 1810.

*Racomitrium alopecurum* Brid. Mant. 79. 1819.

*Rhacomitrium fastigiatum* Wallr. Fl. Krypt. 1: 175. 1831.

*Rhacomitrium heterostichum* var.  $\beta$  *alopecurum* Rueben. Musc. Germ. 208. 1833.

*Trichostomum fasciculare*, var.; Tayl. in Mack. Fl. Hib. 2: 20. 1836.

*Trichostomum saxatile* Tayl. Trans. Bot. Soc. Edinb. 2: 1. 1845.

*Grimmia heterosticha*  $\beta$  *alopecura* C. Muell. Syn. 1: 808. 1849.

*Rhacomitrium affine* Lindb. Acta Soc. Sci. Fenn. 10: 552. 1875.

- Grimmia affinis* Lindb. Musc. Scand. 29. 1879.  
*Racomitrium heterostichum*, subsp. *micropoides* Kindb. Hedwigia 35: 65. 1896.  
*Grimmia subpurida* Stirt. Scot. Nat. 9: 36. 1900.  
*Grimmia calvescens* Stirt. Ann. Scot. Nat. Hist. 10: 112. 1901.  
*Grimmia fusco-viridis* Stirt. l. c.  
*Grimmia papillulata* Stirt. op. cit. 11: 110. 1902.  
*Racomitrium heterostichum*, subsp. *affine* Amann, Fl. Mouss. Suisse, 2: 143. 1912.  
*Racomitrium heterostichum*, var. *Limprichtii* Loeske, Laubm. Eur. 1: 184. 1913.

Stems slender, elongated, with numerous slender, fasciculate branches; plants yellowish green; leaves acute, with shorter hair-points; marginal leaf cells bistratose in upper part of leaf; capsule cylindrical, 1.5-2.5 mm. long.

On rocks, Nova Scotia; Alaska to Washington. Europe.

ILLUSTRATIONS.—Bryol. Eur. pl. 266; Braithw. Brit. Moss Fl. 2, pl. 51 D; Dixon, Handb. Brit. Mosses, (Ed. 3) pl. 21 4y; Loeske, Laubm. Eur. 1913, fig. 56 e; Frye, Bryologist 21, pl. 6.

EXSICCATI.—Glacier Bay, Alaska, W. S. Cooper, August 24, 1916; Mt. Rainier, Washington, J. W. Bailey, August 17, 1917.

7a. Var. *AFFINE* (Schleich.) C. Jens., f. *OBTUSUM* (Sm.) Moenk. Laubm. Eur. 379. 1927.

- Trichostomum obtusum* Sm. Fl. Brit. 1244 (excl. syn.) 1804.  
*Racomitrium obtusum* Brid. Mant. 79. 1819.  
*Grimmia obtusa* Lindb. Musc. Scand. 29. 1879.  
*Racomitrium heterostichum*, f. *obtusum* Boulay, Musc. France 1: 361. 1884.  
*Racomitrium affine*, var. *β obtusum* Limpr. Laubm. 1: 803. 1889.  
*Racomitrium heterostichum*, var. *obtusum* Loeske, Laubm. Eur. 1: 184. 1913.  
*Racomitrium heterostichum*, subsp. *affine*, var. *obtusum* Loeske, Mon. Eur. Grimm. 210. 1930.

Leaves obtuse, entire, mucous or nearly so; margins more than one cell in thickness above the middle of the leaf; short lateral branchlets many; plants short, densely pulvinate.

On moist, shaded rocks, not common. Although the obtuse leaves are very distinctive, the absence of the hyaline point can scarcely be considered as a specific or even varietal character.

ILLUSTRATIONS.—Braithw. Brit. Moss Fl. 2, pl. 51 E.

EXSICCATI.—Macoun, Can. Musci. 287.

7b. Var. *GRACILESCENS* Bryol. Eur. fasc. 25-28. 1845.

- Grimmia heterosticha* γ *gracilescens* C. Muell. Syn. 1: 808. 1849.  
*Racomitrium heterostichum*, f. *gracilescens* Zett. Rev. Grimm. Scand. 120. 1861.  
*Racomitrium affine*, var. *β gracilescens* Lindb. Acta Soc. Sci. Fenn. 10: 553. 1875.  
*Grimmia subpurida* Stirt. Scott. Nat. 9: 36. 1900.

This is an alpine variety with slender, elongated stems and very few or no short lateral branchlets; hair points very short or none; upper leaf margins bistratose, strongly recurved on both sides; costa about 140 μ wide; capsule very small, on a short seta.

ILLUSTRATIONS.—Bryol. Eur. pl. 266 y; Journ. Bot. 68: 305, fig. 2.

EXSICCATI.—Summit of Bald Mountain, near Camden, Maine, October 3, 1905, Alice M. Crockett (Holz. Musci Acro. Bor.-Am. 186).

7c. Var. *SUDETICUM* (Funck) n. comb.

- Trichostomum microcarpon* Hedw. Sp. Musc. 112. 1801.  
*Trichostomum sudeticum* Funck, Moost. 26. 1821.  
*Dryptodon sudeticus* Brid. Bryol. Univ. 1: 195. 1826.  
*Racomitrium microcarpon* β *sudeticum* Huebn. Musc. Germ. 302. 1833.  
*Trichostomum gracile* Huebn. op. cit. l. c.  
*Grimmia procera* Bals. & De Not. Pugill. no. 17. 1836.  
*Racomitrium sudeticum* Bryol. Eur. fasc. 25-28. 1845.  
*Grimmia microcarpa* C. Muell. Syn. 1: 804. 1849.

*Rhacomitrium microcarpon* Lindb. Acta Soc. Sci. Fenn. 10: 524. 1875.

*Rhacomitrium heterostichum*, subsp. *sudeticum* Dixon, Stud. Handb. Brit. Mosses (Ed. 1) 154. 1896.

Plants in loose, yellowish green wide patches; branches ascending; short lateral branchlets few or none; leaves not conspicuously twisted or curled when dry; leaf margins revolute toward the apex on one side only, 2-3-stratose; hyaline points acute, dentate, short; cells of the upper two thirds of the leaf isodiametrical; costa about 100  $\mu$  wide; seta 2-3 mm. long; capsule ovoid, 1-2 mm. long.

Type locality, "Am Weisswasser im Reisengebirge." (Bohemia-Prussia). Discovered by C. Funck in 1819.

On rocks, Alaska and Yukon to Oregon and Idaho; Labrador to Nova Scotia, New Hampshire and Pennsylvania; Greenland; Europe. A form with the costa papillose, *R. sudeticum*, f. *papillosa* C. Jens. (*R. Jensenii* Kindb.), has been collected in Greenland.\*

ILLUSTRATIONS.—Bryol. Eur. pl. 264; Hedw. Sp. Musc. pl. 23; Broth. Laubm. Fenn. fig. 35 G-K; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 21 c; Roth, Eur. Laubm. 1, pl. 34; Grout, M.H.M. fig. 60; Loeske, Laubm. Eur. 1913, figs. 56a, 57, 58; Frye, Bryologist 21, pl. 3; Journ. Bot. 68: 305, fig. 1, 1930.

EXSICCATI.—Drumm. Musc. Am. 129 (as *Trichostomum*); Macoun, Can. Musci 286, 156, 404, 405; Holz. Musci Acro. Bor.-Am. 622, 272, 62; Fernald, Wiegand & Bartram 6463; Piper 258; Merrill 36; Small 236; Leiber 102, 199. Sull. Musc. Allegh. 134; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 144, (Ed. 2) 218.

Var. *SUDETICUM*, f. *occidentale* (Ren. & Card.) n. comb.

*Rhacomitrium heterostichum*, var. *occidentale* Ren. & Card. Bot. Gaz. 15: 41. 1890 (February).

*Rhacomitrium brevipes* Kindb. Bul. Torr. Club 17: 272. 1890 (November).

*Rhacomitrium micropus* Kindb. in Mac. Cat. Can. Pl. 6: 97. 1892.

*Rhacomitrium occidentale* Ren. & Card. Musc. Am. Sept. 25, 1893.

*Rhacomitrium heterostichum*, subsp. *sudeticum*, var. *occidentale* Frye, Bryologist 21: 3. 1918.

Differs from the var. *sudeticum* in having the surface of the hyaline leaf point denticulate.

Type locality, on rocks, Lost Lake, Oregon, collected by L. F. Henderson.

On rocks, British Columbia to Oregon.

ILLUSTRATIONS.—Frye, Bryologist 21, pl. 4.

EXSICCATI.—Holz. Musc. Acro. Bor.-Am. 573.

7d. Var. *Macounii* (Kindb.) n. comb.

*Rhacomitrium Macounii* Kindb. Bull. Torr. Club 16: 93. 1889.

*Rhacomitrium robustifolium* Kindb. op. cit. 17: 272. 1890.

*Rhacomitrium alternatum* C. M. & Kindb. in Mac. Cat. Can. Pl. 6: 73. 1892.

*Rhacomitrium attenuatum* C. M. & Kindb. l. c.

*Grimmia robustifolia* Kindb. Eur. and N. Am. Bryin. 225. 1897.

*Grimmia attenuata* Kindb. l. c. 228.

Plants green or brownish, yellowish green on the tips of the branches; stems 2-8 cm. long; leaves ovate-lanceolate, loose and somewhat twisted or curled when dry, recurved when moist; hyaline points present on some of the upper leaves, short, smooth, blunt; leaf margins revolute toward the apex, bistratose; apical leaf cells isodiametrical; seta about 5 mm. long; capsule ellipsoidal or cylindrical, 1-1.8 mm. long.

Type locality, "In large masses, on huge boulders between Cathedral Mountains and Mount Stephens near Field, Rocky Mountains" (British Columbia). Collected by John Macoun, August 1885.

On alpine and subalpine rocks, Nova Scotia, British Columbia, Washington.

ILLUSTRATIONS.—Frye, Bryologist 21, pl. 6.

EXSICCATI.—Macoun, Can. Musci 245, 282, 91a, 284 (284 is the duplicate type of *R. robustifolium*). Holz. Musci Acro. Bor.-Am. 436.

7e. Var. *ramulosum* (Lindb.) n. comb.

*Bryum microcarpum* Funck, Krypt. Cow. Fichtel. 2: 3. 1801.

*Racomitrium microcarpon* Brid. Musc. Recent. Suppl. 4: 79. 1819.

*Trichostomum heterostichum*, var.  $\beta$  *microcarpum* Wahlenb. Fl. Suec. 2: 751. 1826.

\*Macoun, John, Catalogue of Canadian Plants 7: 225. 1902.

- Grimmia ericoides* Brid. Bryol. Univ. 1: 768. 1827.  
*Grimmia microcarpa* C. Muell. Synops. 1: 804. 1849.  
*Racomitrium ramulosum* Lindb. Acta Soc. Sci. Fenn. 10: 550. 1875.  
*Grimmia ramulosa* Lindb. Musc. Scand. 29. 1879.  
*Racomitrium heterostichum*  $\gamma$  *microcarpum* Boulay, Musc. France 1: 369. 1884.  
*Racomitrium heterostichum*, var. *microcarpum* Husn. Musc. Gall. 140. 1887.  
*Racomitrium heterostichum*, subsp. *ramulosum* Dixon, Stud. Handb. Brit. Mosses (Ed. 1). 1896.

Plants in loose, flat, yellowish green tufts; stems with numerous short lateral branchlets; leaves loosely curved-imbricated when dry, curved downward, then erect-spreading when moist, oblong-lanceolate, acuminate, with a short, spinulose, hyaline point; margins revolute, unistratose; costa flat, 2-3-stratose; cells sinuose, linear and yellowish at base, or one or two rows in the basal angles quadrate and hyaline, the upper ones predominantly elongate. Dioicous; seta 4-5 mm. long, yellowish, arcuate; capsule erect, ellipsoidal or cylindrical, smooth, 1.8-2 mm. long, light brown; calyptra mitrate, somewhat papillose, at the apex; lid with a subulate beak; annulus revolute, of 2-3 rows of cells; peristome teeth united at the base, finely papillose, 0.4-0.6 mm. long, cleft to the base into 2-3 filiform divisions; spores olive green, finely granular, 10-15  $\mu$  in diameter.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. pl. 268; Limpr. Laubm. Eur. 1, fig. 206; Braithw. Brit. Moss Fl. 2, pl. 51 F; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 21 b; Roth, Eur. Laubm. 1, pl. 34; Grout, M. H.M. fig. 59; Loeske, Laubm. Eur. 1913, figs. 56g, 58, 61b; Frye, Bryologist 21, pl. 12.

EXSICCATI.—Drumm. Musc. Am. 128 (as *Trichostomum*); Sull. Musc. Allegh. 133; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 144, (Ed. 2) 219; Macoun, Can. Musci 293, 100; Holz. Musci Acro. Bor.-Am. 621; Small 9160, 19; Henderson 12043; Gardner 557; R. & C. Musc. Am. Sept. 366; Aust. Musc. Appal. 149.

On rocks or cliffs, Alaska and Yukon to Greenland, southward to Oregon and Georgia. Europe. Asia. Owing to the confusion which exists in regard to the application of the name *R. microcarpum* of Bridel, it seems best to follow Dixon and others in using the name *R. ramulosum* of Lindberg.

#### 8. RHACOMITRIUM CANESCENS Brid. Musc. Recent. Suppl. 4: 78. 1819.

- Grimmia canescens* C. Muell. Syn. 1: 807. 1849.  
*Racomitrium ericoides*  $\beta$  *canescens* Lindb. Oefvers. Vet.-Ak. Foerh. 23: 553. 1867.  
*Grimmia ericoides* var.  $\beta$  *canescens* Lindb. Musc. Scand. 29. 1879.  
*Racomitrium consocians* Stirt. Ann. Scot. Nat. Hist. 16: 179. 1907.

Plants in loose yellowish green or grayish green tufts; stems erect or spreading 2-10 cm. long; elongated branches few or none; short tuft-like lateral branchlets few or none; leaves crowded, loosely imbricated when dry, curved, lanceolate, strongly papillose on both surfaces, usually hyaline pointed; hyaline points dentate, papillose; margins revolute, unistratose; costa percurrent; upper and median leaf cells 1-2 : 1, 8-10  $\mu$  in diameter; basal cells 4-6 : 1, all strongly papillose with simple papillae. Dioicous; seta smooth, 0.5-2.5 cm. long, twisted to the left; capsule ellipsoid, about 2 mm. long; lid long beaked; calyptra mitrate, very papillose throughout; annulus of 2 rows of reddish cells, revolute; stomata in 2 rows; peristome teeth united at the base 1.3-1.6 mm. long, finely papillose; spores yellowish, smooth, 8-10  $\mu$  in diameter.

Type locality, Giessen, Germany. Discovered by Dillenius.

ILLUSTRATIONS.—Bryol. Eur. pl. 270; Broth. Laubm. Fenn. fig. 35 L-N; Braithw. Brit. Moss Fl. 2, pl. 51 D; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 21 D; Roth, Eur. Laubm. 1, pl. 34; Grout, M.H.M. fig. 62; Loeske, Laubm. Eur. 1913, figs. 2 f, 56 h, 59, 60; Frye, Bryologist 21, pl. 8.

EXSICCATI.—Drumm. Musc. Am. 134 (as *Trichostomum*); Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 147, (Ed. 2) 221, 222; Macoun, Can. Musci 295; Grout, N. Am. Musci 103; Holz. Musci Acro. Bor.-Am. 341 b; Henderson 12045, 12071; R. & C. Musc. Am. Sept. 368; Aust. Musc. Appal. Suppl. 503.

On exposed rocks in alpine or hilly regions, Alaska and Yukon to California and Montana; Labrador to New Hampshire and Ontario. Greenland. Europe. Asia. Africa.

#### 8a. f. ERICOIDES (Brid.) Moenk. Laubm. Eur. 380. 1927.

- Racomitrium ericoides* Brid. Musc. Recent. Suppl. 4: 78. 1819.  
*Racomitrium canescens* Var.  $\gamma$  *ericoides* Bryol. Eur. fasc. 25-28. 1845.  
*Grimmia canescens*  $\beta$  *ericoides* C. Muell. Syn. 1: 807. 1849.  
*Grimmia ericoides* Lindb. Musc. Scand. 29. 1879.  
*Racomitrium canescens* var. c. *intermedium* Venture and Bottini, Soc. Critt. Ital. 3: 214. 1884.

Plants yellowish green, with numerous, short, tuft-like lateral branchlets; most of the leaves with hyaline points.

Type locality, Germany.

Alaska to Oregon and Montana; Nova Scotia; Greenland; Europe; Japan.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 271; Frye, Bryologist 21, *pl.* 10.

EXSICCATI.—Macoun, Can. Musci 295a; Allen, Mosses Casc. Mts. 32; Baker, Pac. Slope Bry. 559; Holz. Musci Acro. Bor.-Am. 139a, 139b.

8b. *f. epilosum* (Milde) n. comb.

*Racomitrium canescens*, var. *epilosum* Milde, Bryol. Siles. 160. 1869.

*Racomitrium canescens*, var. *muticum* Vent. Rev. Bryol. 6: 55. 1879.

*Racomitrium brevipes*, var. *muticum* Kindb. Bull. Torr. Club 17: 272. 1890.

*Racomitrium canescens*, var. *muticum* Kindb. in Mac. Cat. Can. Pl. 6: 77. 1892.

Plants green; short, tuft-like lateral branchlets few; leaves muticous or nearly so; *Pl.* 11.

This is a form with muticous leaves. It has been collected in Greenland and in British Columbia, and it undoubtedly occurs elsewhere in North America.

Another form with muticous, nearly smooth leaves, named *R. canescens Delamerii* Ren. & Card., has been collected on Miquelon Island,\* but I have seen no specimens.

#### 9. RHACOMITRIUM LANUGINOSUM (Hedw.) Brid. Musc. Recent. Suppl. 4: 78. 1819.

*Trichostomum lanuginosum* Hedw. Sp. Musc. 109. 1801.

*Trichostomum canadense* Rich.; Michx. Fl. Am. Bor. 2: 296. 1803.

*Racomitrium canadense*, Brid. Bryol. Univ. 217. 1826.

*Racomitrium borbonicum*, op. cit. 217.

*Grimmia lanuginosa* C. Muell. Syn. 1: 806. 1849.

*Racomitrium hypnoides* Lindb. Oefvers. Vet.-Ak. Foerh. 552. 1867.

*Grimmia hypnoides* Lindb. Musc. Scand. 29. 1879.

Plants green to grayish green; stems 10–20 cm. long, spreading, with numerous elongated branches or short tuft-like, lateral branchlets; leaves lanceolate, 4–5 mm. long, loosely imbricated when dry, curved, then erect-spreading when moist, acuminate; *hyaline point long, papillose, and erose or ciliate*; margins revolute, unistratose; leaf cells strongly sinuose or nodulose, *upper and median cells 3–8 : 1*, except a row of isodiametrical cells along the margins of the leaf; basal cells 6–10 : 1. Dioicous; *seta 3–7 mm. long, papillose towards the base, twisted to the left*; capsule ovoid, about 1.5 mm. long, erect, narrowed toward the mouth; calyptra mitrate, papillose at apex; lid long beaked; annulus revolute, of 3–5 rows of cells; stomata in one row; peristome teeth 0.7–0.9 mm. long, very papillose, not swollen at the joints, orange colored, deeply 2-cleft almost to the base; *spores yellowish, smooth 8–12  $\mu$  in diameter*.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. *pl.* 269; Limpr. Laubm. Eur. 1, *fig.* 207; Braithw. Brit. Moss Fl. 2, *pl.* 52c; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 21E; Roth, Eur. Laubm. 1, *pl.* 34; Grout, M.H.M. *fig.* 61; Loeske, Laubm. Eur. 1913, *fig.* 2, 59, 61c; Frye, Bryologist 21, *pl.* 11.

EXSICCATI.—Drumm. Musc. Am. 134; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 148, (Ed. 2) 223; Sull. Musc. Allegh. 131; R. & C. Musc. Am. Sept. 31, 32. Macoun, Can. Musci 294; Merrill 34; Cooper 94, 43, 285; Fernald, Wiegand & Bartram 6464; Leiberg 186.

On rocks, Alaska, Yukon and Northwest Territories to Oregon and Idaho; Greenland; Labrador; Quebec, Nova Scotia, Newfoundland; Maine, New Hampshire; Europe; Asia; Africa; Central America; Australasia.

*W. S. Cooper* 94, from Knyg Lake, Stikine River, Alaska, August 14, 1919, is a form with falcate, second leaves which might be maintained as *f. falcata* Boulay. *Fernald, Wiegand & Bartram* 6464 from granite ledges on Hodge's Hill, Newfoundland, belongs to *f. robusta* (Lindb.) Moenk. Laubm. Eur. 380, 1927. A shade form with slender branchlets, and the hyaline points of the leaves short, known as var. *subimberbis* Hartm., has been collected on Miquelon Island.

*Racomitrium cyclodictyon* Card. & Thér. Proc. Wash. Acad. Sci. 4: 308. 1902. Known only from Muir Glacier, Alaska. Dr. T. C. Frye,† who has studied type material from the Missouri Botanical Garden,

\*Barnes & Heald, Analytic Keys to the Genera and Species of North American Mosses, 291. 1897.

†Frye, T. C., The Racomitriums of Western North America, Bryologist 21: 1. 1918.

reports that there are only two capsules, both of them mature, but lacking peristome, mature calyptra, or lid. The leaf cells resemble those of *Grimmia* rather than *Rhacomitrium*. Dr. Frye concludes that "the final disposition of the plant will likely have to await specimens with peristome."

"Plants densely caespitose, small, blackish-brown or reddish-brown. Stems depressed, 6 cm. or less long, pinnately much branched, branches crowded, erect, short, 3-5 mm.; long; short tuft-like branches wholly wanting. Leaves when dry suberect, hardly flexuous; when moist erecto-patent; up to 1.25 mm. long, up to 0.5 mm. wide, ovate-lanceolate, muticous; margin entire, revolute, below only one cell thick throughout; vein somewhat slender, 35-40  $\mu$  thick, vanishing below the apex, its cells in cross section subequal. Cells of leaf base near the vein somewhat rectangular or sublinear, not sinuose; cells of leaf tip and leaf middle round or short-ovate, 8-12  $\mu$  wide, incrassate at the side, smooth but convex on both sides of the leaf, very strongly convex on the upper side. Perichaetial leaves much larger than the others, at base somewhat subvaginate, long acuminate, erect when moist. Seta short, purple but finally blackish, twisted to the right when dry about 5 mm. long. Capsule erect, narrowly cylindric, 1.5 mm. long, 0.3 mm. in diameter. Spores minutely granulose, 16-17  $\mu$  in diameter." Frye, l. c.

#### ADDITIONS

\**PTYCHOMITRIUM SERRATUM* Bry. Eur. fasc. 2-3, Mon. 4. 1837 (name only).

*Brachysteleum serratum* C. Muell. Syn. 1: 768. 1849.

*Glyphomitrium serratum* Mitt. Journ. Linn. Soc. 12: 106. 1869.

Size, appearance and general structure of *P. Gardneri*; leaves very strongly serrate, with teeth of several cells; basal cells near costa linear, thin-walled. Seta about 5 mm. long; calyptra with serrated ridges near the apex; spores in late summer. Type from South America.

On shaded rocks, McKettrick Canyon, Guadalupe Mts., Culberson Co., Texas, Aug. 15-17, 1924. (Carlsbad Cavern Expedition of the Nat. Geographic Society). Also from the same locality by J. A. Moore and J. A. Steyermark, 1931. Both specimens determined and communicated by E. B. Bartram. (See Bryologist 29: 71. 1926.) This is the only known station for this plant north of Mexico. Sterile plants would be extremely difficult to separate from *P. Gardneri* but for the broader-pointed leaves and much shorter leaf cells in lower part of leaf.

*Grimmia columbica* Kindb. = *G. calyptrata* Hook.

\* The occurrence of this interesting plant within the U. S. was overlooked until the whole monograph was paged and indexed.—A. J. G.

## ARTIFICIAL KEY TO THE GRIMMIACEAE.

By A. J. GROUT.

- |  |                            |
|--|----------------------------|
| 1. Leaves ecostate.....  | 2.                         |
| Leaves strongly costate.....   | 3.                         |
| 2. Leaf cells with simple papillae.....  | 4. <i>Braunia</i> .        |
| Leaf cells with bifurcate papillae.....  | 5. <i>Hedwigia</i> .       |
| *3. Leaves when dry crispate, curled, twisted or falcate.....  | 4.                         |
| Leaves when dry not as above or slightly twisted.....  | 8.                         |
| 4. The upper leaves or at least the perichaetial leaves piliferous with a hyaline apex.....  | 2. <i>Grimmia</i> , A.     |
| Leaves muticous.....   | 5.                         |
| 5. Perichaetial leaves convolutely clasping the seta.....  | 1. <i>Glyphomitrium</i> .  |
| Perichaetial leaves not clasping.....  | 6.                         |
| 6. Capsule long exserted.....  | 7.                         |
| Capsule immersed, emergent or shortly exserted.....  | 2. <i>Grimmia</i> , A.     |
| 7. Seta arcuate.....   | 6. <i>Campylostelium</i> . |
| Seta straight.....   | 7. <i>Ptychomitrium</i> .  |
| 8. Basal leaf cells linear to short-rectangular with more or less sinuose walls....  | 9.                         |
| Basal leaf cells various but not noticeably sinuose.....   | 10.                        |
| 9. Peristome teeth cleft to the base into 2-3 linear divisions.....  | 8. <i>Rhacomitrium</i> .   |
| Peristome teeth not as above, often somewhat perforate or irregularly divided.   | 2. <i>Grimmia</i> , B.     |
| 10. Central strand of stem lacking; costa somewhat radiculose at base; capsule oblate spheroidal, immersed; lid flat, persistent on the columella; peristome lacking; aquatic..... | 3. <i>Scouleria</i> .      |
| Central strand present; costa not radiculose; capsules mostly elongated to cylindrical; peristome present.....   | <i>Grimmia</i> , C.        |

## GRIMMIA A.

- |   |                              |
|---|------------------------------|
| 1. Basal leaf cells mostly thin and smooth walled, not or slightly sinuose or incrassate.....   | 2.                           |
| Basal leaf cells incrassate and sinuose.....  | 4.                           |
| 2. Leaves 1.5-2 mm. long, subulate, strongly twisted when dry.....  | 40. <i>G. incurva</i> .      |
| Leaves 2-3.5 mm. long.....  | 3.                           |
| 3. Leaves linear subulate, homomallous-falcate when dry, hooked when moist..  | 39. <i>G. hamulosa</i> .     |
| Leaves linear-lanceolate, curved or twisted when dry.....   | 41. <i>G. trichophylla</i> . |
| 4. Leaves 2-3 mm. long, margin recurved at base on one side.....  | 46. <i>G. Hartmani</i> .     |
| Leaves 0.75-1.5 mm. long, margins plane or slightly recurved.....   | 5.                           |
| 5. Leaves linear-lanceolate, incurved, twisted and spirally contorted when dry; plants in large, loose soft, yellowish green tufts..... | 37. <i>G. torquata</i> .     |
| Leaves ovate-lanceolate, appressed and spirally inrolled on the stem when dry; plants in dense, smooth, gray or blackish tufts.....     | 38. <i>G. funalis</i> .      |

## GRIMMIA B.

(41. *G. trichophylla* may be sought here, also nos. 8, 14, 20, *Rhacomitrium* species and forms of No. 5).

- |   |   |
|---|---|
| 1. Leaves muticous.....                   | 2.                                      |
| At least the upper leaves piliferous..... | 3.                                      |
| 2. Seta straight.....                     | 34. <i>G. ovalis</i> f. <i>mutica</i> . |
| Seta curved, at least when moist.....     | 45. <i>G. densa</i> .                   |

\*The contortion of the leaves, the sinuosity of the basal cells and the presence or absence of a hair point vary in some species, so that if your plant does not key out satisfactorily under one heading, try its alternative.

No key can be made that will key out sterile plants in all cases.

This key is an attempt to assist Mr. Jones' excellent keys by using gametophyte characters in the early part of the key when possible.

- |  |                                |
|--|--------------------------------|
| 3. Hair point smooth or nearly so.....   | 4.                             |
| Hair point plainly denticulate or spinulose.....   | 6.                             |
| 4. Leaf cells of upper leaf papillose.....   | 47. <i>G. elatior</i> and 46a. |
| Leaf cells not papillose.....  | 5.                             |
| 5. Hyaline point very short.....   | 46. <i>G. Hartmani</i> .       |
| Hyaline point $\frac{1}{3}$ the length of the lamina.....  | 34. <i>G. ovalis</i> .         |
| Hyaline points 2-8 times length of lamina.....   | 30. <i>G. Brittoniae</i> .     |
| 6. Margins plane or slightly recurved below.....   | 7.                             |
| Margins recurved or at least plainly revolute.....   | 9.                             |
| 7. Hyaline leaf points about $\frac{1}{10}$ the length of the lamina.....                        | 31. <i>G. elongata</i> .       |
| Hyaline points of the upper leaves $\frac{1}{4}$ the length of the lamina or longer....          | 8.                             |
| 8. Margins bistratose above.....   | 35. <i>G. pulvinata</i> .      |
| Leaves bistratose throughout.....  | 33. <i>G. arizonae</i> .       |
| 9. Capsule erect immersed; found east of the Mississippi.....                                    | 32. <i>G. pilifera</i> .       |
| Capsules emergent or exserted on a curved seta; plants found in the Rocky Mts. and westward..... | 10.                            |
| 10. Dioicous; annulus simple, persistent.....  | 43. <i>G. Leibergii</i> .      |
| Autoicous; annulus compound, deciduous.....  | 44. <i>G. decipiens</i> .      |

## GRIMMIA C.

- |  |  |
|--|--|
| 1. Upper leaves muticous or with a few hyaline apical cells.....   | 2.   |
| Upper, or at least the perichaetial, leaves with hyaline hair points.....  | 10.  |
| 2. Margins plane.....  | 3.   |
| Margins revolute or recurved.....  | 9.   |
| 3. Leaf unistratose throughout.....  | 4.   |
| Margins or entire leaf of more than one layer of cells.....  | 6.   |
| 4. Columella attached to the lid and dehiscent with it.....  | Subgenus <i>Schistidium</i><br>(p. 5), nos. 1, 2, 4, 6b. |
| Columella free from the lid, persistent.....   | 5.   |
| 5. Leaves keeled.....  | 27. <i>G. coloradensis</i> .                             |
| Leaves not keeled.....   | 12. <i>G. mollis</i> .                                   |
| 6. Columella attached to the lid and dehiscent with it.....  | 5. <i>G. alpicola</i> .                                  |
| Columella free from the lid and persistent.....  | 7.   |
| 7. Leaves strongly keeled, often with short hyaline point; costa terete or semi-terete, prominently convex on the dorsal side of the leaf.....                               | 25. <i>G. teretinervis</i> .                             |
| Leaves not keeled, muticous, costa flattened, often somewhat obscure, especially in the upper part of the leaf, not prominently convex on the dorsal side....                | 8.   |
| 8. Calyptra cucullate; annulus none; stomata none; spores 7-8 $\mu$ in diameter..  | 22. <i>G. brevirostris</i> .                             |
| Calyptra usually mitrate; annulus and stomata present; spores 10-15 $\mu$ in diameter.....   | 23. <i>G. unicolor</i> .                                 |
| 9. Margins unistratose.....  | 3. <i>G. Dupretii</i> .                                  |
| Margins or entire leaf bistratose above.....   | No. 5 and varieties 6c and 6g.                           |
| 10. Calyptra large, covering the capsule to the middle or below, campanulate-mitrate, plicate; upper leaves with very long hyaline points, often longer than leaf blade..... | Subgenus <i>Coscinodon</i><br>(p. 7).                    |
| Calyptra small, scarcely longer than the lid; hair points various.....   | 11.  |
| 11. Seta arcuate or flexuose, at least when moist.....   | 36. <i>G. orbicularis</i> .                              |
| Seta straight or nearly so, nearly always longer than the capsule.....   | 12.  |
| 12. Nos. 13-21, 24-29 as in key on page 7, starting with c near bottom of page.  |  |

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*f. gracilescens*, 56.  
*var. gracilescens*, 56.  
*var. Limprichtii*, 56.  
*var. Macounii*, 57.  
*γ microcarpum*, 57.  
*var. microcarpum*, 58.  
*ssp. micropoides*, 56.  
*f. obtusum*, 56.  
*var. obtusum*, 56.  
*var. occidentale*, 57.  
*ssp. ramulosum*, 58.  
*var. sudeticum*, 57.  
*f. occidentale*, 57.  
*ssp. sudeticum*, 57.  
*var. occidentale*, 57.  
*ssp. vulgare*, 55.
- hypnoides*, 59.  
*incurvum*, 42.  
*lanuginosum*, 59.  
*Macounii*, 57.  
*microcarpum*, 57.  
*β sudeticum*, 56.  
*microcarpum*, 57.  
*var. Palmeri*, 54.  
*micropus*, 57.  
*Nevii*, 53.  
*obtusifolium*, 53.  
*occidentale*, 57.  
*oreganum*, 54.  
*Palmeri*, 54.  
*patens*, 52.  
*ramulosum*, 58.  
*robustifolium*, 57.  
*speciosum*, 54.  
*sudeticum*, 56.  
*tenuinerve*, 54.  
*varium*, 54.
- Schistidium*, II.  
*Agassizii*, II.  
*alpicola*, 13.  
*var. eualpicola*, 13.  
*var. γ latifolium*, 14.  
*var. β rivulare*, 13.  
*ambiguum*, 18.  
*angustum*, II.  
*anodon*, 22.  
*apocarpum*, 14.  
*subvar. γ β alpicola*, 13.  
*γ atrum*, 13.  
*ssp. brunnescens*, 15.  
*ssp. confertum*, 17.  
*var. brunnescens*, 15.
- var. confertum*, 17.  
*β gracile*, 17.  
*var. helvetica*, 13.  
*ssp. pulvinatum*, 16.  
*var. γ rivulare*, 13.  
*var. tenerum*, 16.  
*brunnescens*, 15.  
*ciliatum*, 45.  
*confertum*, 17.  
*gracile*, 17.  
*lineare*, 12.  
*longidens*, 17.  
*maritimum*, 12.  
*nodulosum*, 17.  
*plagiopodium*, 23.  
*pulvinatum*, 16, 22.  
*tenerrimum*, 16.  
 (?) *teretinerve*, 27.
- Scouleria*, 42.  
*aquatica*, 43.  
*var. catuliformis*, 43.  
*var. nigrescens*, 43.  
*var. virescens*, 43.  
*marginata*, 43.  
*Muelleri*, 43.  
*Nevii*, 43.
- Trichostomum aciculare*, 52.  
*β acutifolium*, 53.  
*α obtusifolium*, 53.  
*affine*, 55.  
*alopecurum*, 55.  
*canadense*, 59.  
*carnosum*, 55.  
*cataractarum*, 53.  
*decipiens*, 40.  
*fasciculare*, 54, 55.  
*β secundum*, 53.  
*β protensum*, 53.  
*funale*, 37.  
*gracile*, 56.  
*heterostichum*, 55.  
*var. β microcarpum*, 57.  
*incurvum*, 42.  
*lanuginosum*, 59.  
 (?) *lutescens*, 54.  
*maritimum*, 54.  
*microcarpum*, 56.  
*obtusifolium*, 52.  
*obtusum*, 53, 56.  
*ovatum*, 25, 33.  
*patens*, 52.  
*β funalis*, 37.  
*β piliferum*, 40.  
*pulvinatum*, 34.  
*β alpestris*, 29.  
*saxicola*, 47.  
*saxatile*, 55.  
*stenocarpum*, 55.  
*sudeticum*, 56.
- Weisia geniculata*, 47.  
*incurva*, 48.
- Zygodon torquatus*, 36.

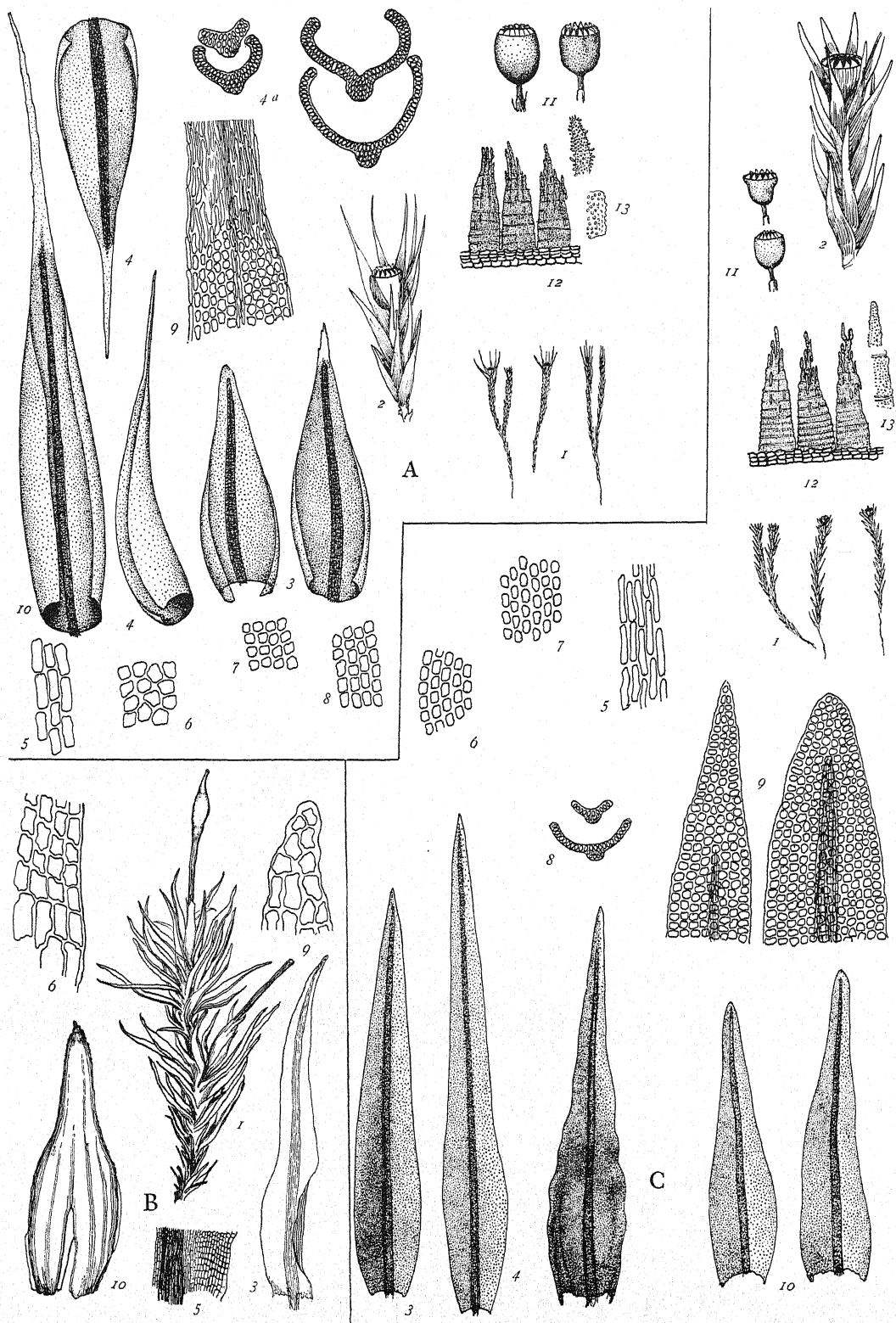


PLATE I.

PLATE I. A. *Grimmia heterophylla*. 1, Plants wet and dry  $\times 1$ ; 2, upper portion of fertile stem  $\times 5$ ; 3, lower leaves  $\times 30$ ; 4, upper leaves  $\times 30$ ; 4a, cross sections of same  $\times 30$ ; 5, basal leaf cells near costa; 6, angular cells; 7, median cells; 8, marginal cells (5-8  $\times 300$ ); 9, apical cells  $\times 300$ ; 10, perichaetial leaf  $\times 30$ ; 11, capsules, wet and dry  $\times 5$ ; 12, peristome teeth  $\times 30$ ; 13, portions of tooth showing papillae  $\times 300$ . Drawings by Seville Flowers.

B. *Glyphomitrium canadense*. 1, Plant with immature capsule  $\times 3.5$ ; 3, leaf  $\times 28$ ; 5, basal  $\frac{3}{8}$  of leaf  $\times 72$ ; 6, cells of basal leaf angle  $\times 215$ ; 9, apical cells  $\times 328$ ; 10, calyptra  $\times 30$ . Drawings by Miss E. L. Curtis.

C. *Grimmia Agassizii* (from British Columbia). 1, Plants  $\times 1$ ; 2, upper portion of fertile stem  $\times 5$ ; 3, upper leaf  $\times 20$ ; 4, two lower leaves  $\times 20$ ; 5, basal leaf cells near costa  $\times 300$ ; 6, alar cells  $\times 300$ ; 7, median cells  $\times 300$ ; 8, cross sections of leaf  $\times 20$ ; 9, leaf apices  $\times 300$ ; 10, perichaetial leaves  $\times 30$ ; 11, capsules  $\times 4$ ; 12, peristome teeth  $\times 30$ ; 13, portions of teeth  $\times 300$ . Drawings by Seville Flowers.

PLATE 2. A. *Grimmia cribrosa* (from Bryol. Eur. pl. 230). 2, 3, lower and upper leaf respectively; 4, perichaetial leaf; 5x, cross sections of perichaetial leaf; 6a, basal and 6b, apical areolation; 7ax, cross section of calyptra; 11, peristome; 11a, adherent annulus; 12, 13, 14, variations in peristome teeth.

Lower right. *Grimmia alpicola* (from Bryol. Eur. pl. 234).

Above. *Grimmia alpicola latifolia* (from E.-P. (Ed. 2) 10: fig. 252). G, fruiting plant; H, stem leaf; J, leaf apex; K, portion of leaf base; L, capsule; M, peristome.

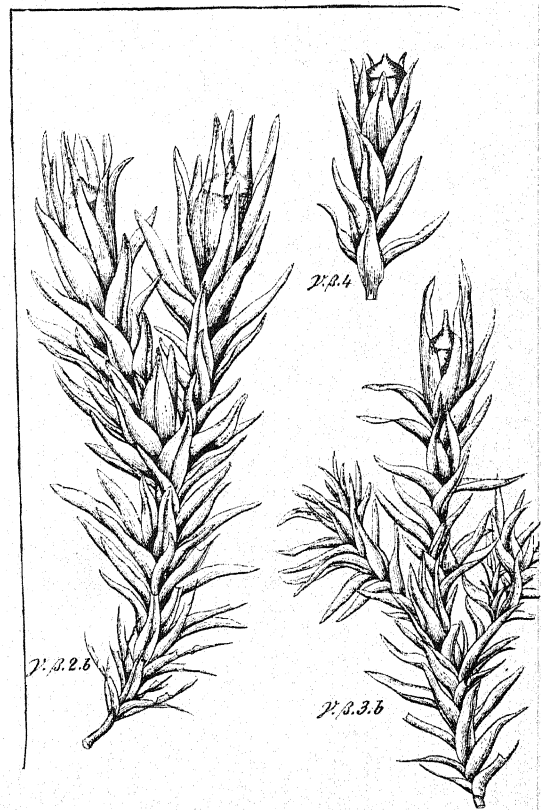
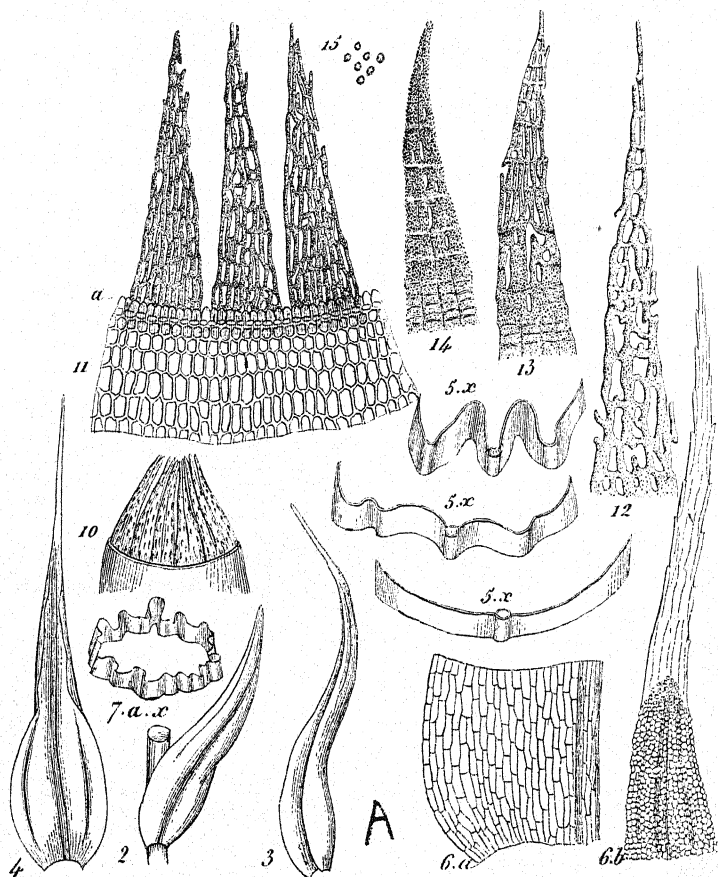
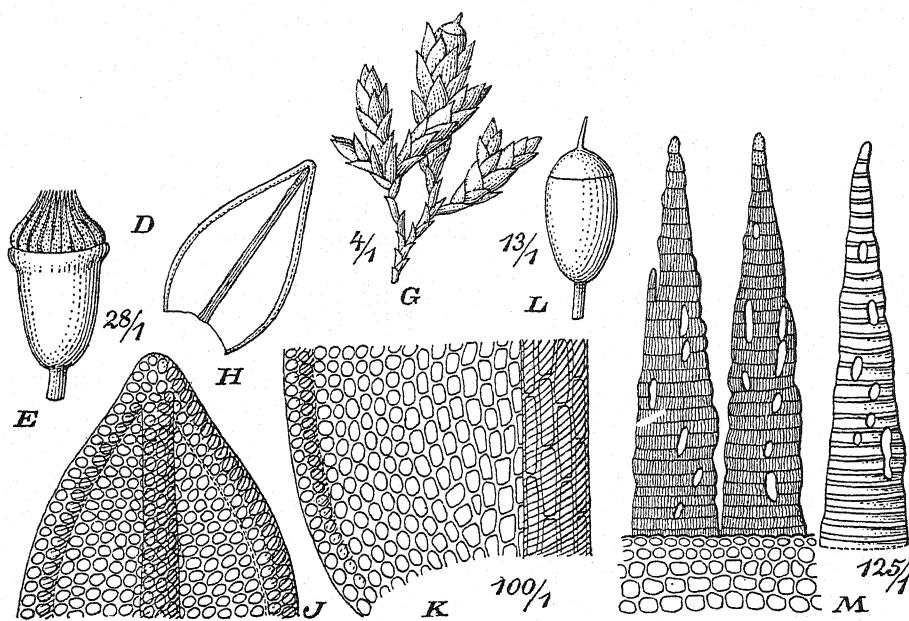


PLATE II.

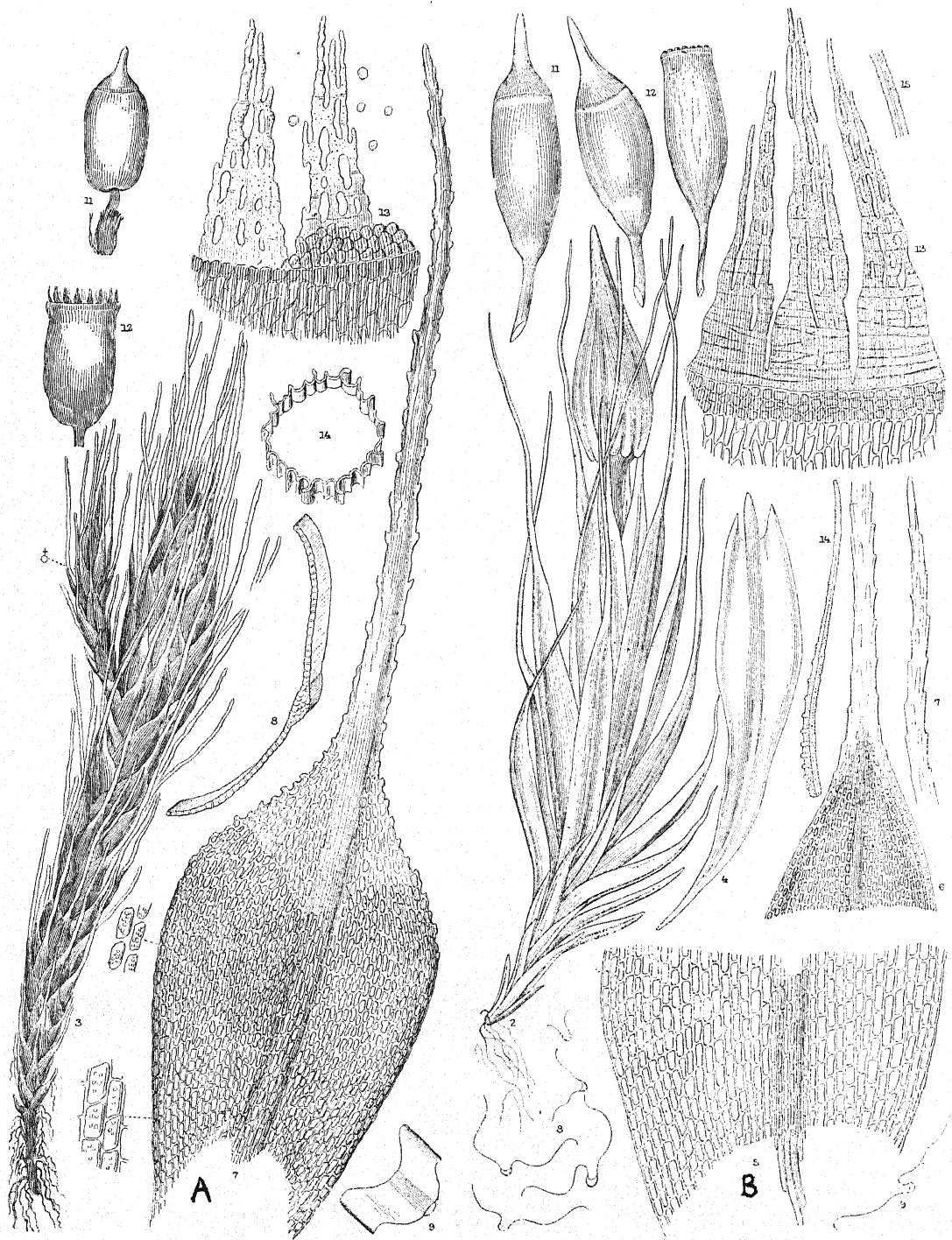


PLATE III.

PLATE 3. A. *Grimmia Wrightii* (from Sull. Icones, *pl.* 45). 3, plant much magnified, showing fertile plant with antheridial bud; 7, leaf; 8, 9, cross sections of same; 11, 12, capsules; 13, part of annulus and peristome; 14, cross section of calyptra.

B. *Grimmia calyptrata* (from Sull. Icones, *pl.* 44). 2, branch enlarged; 4, stem leaf; 5, 6, base and apex respectively of leaf, showing areolation; 7, upper portion of leaf apex; 8, cross sections of leaf; 11, 12, capsules; 13, part of peristome; 14, side view of same, 15, upper portion.

PLATE 4. A. *Grimmia mollis* (from Bryol. Eur. pl. 253). 5, leaves; 6, cross section of upper part of leafy stem; 5a, apical leaf cells; 5b, basal leaf cells; 10, perichaetial leaf; 10a, apex of same.

C. (Lower left) *Grimmia glauca* (from Bryologist 9: 29) a, plants  $\times 1$ ; a, b, c, leaves  $\times 13$ ; d, alar cells  $\times 270$ ; e, cells above the alar  $\times 270$ ; f, median cells  $\times 270$ ; g, apical cells  $\times 138$ ; h, cross section of lower portion of leaf  $\times 138$ ; i, cross section from the upper part of a leaf  $\times 138$ .

B. *Grimmia Raui* (from Bull. Torr. Bot. Club, 22: pl. 248). 1, plants  $\times 1$ ; 2, plant enlarged; 3, antheridial branch; 4, archegonial branch; 5, 6, 7, outlines of leaves; 8, antheridia; 9, basal half of leaf; 10, leaf apex; 11, calyptra; 12, capsule with lid; 13, capsule without lid; 14, old capsule; 15, two peristome teeth; 16, annulus; 17, spores.

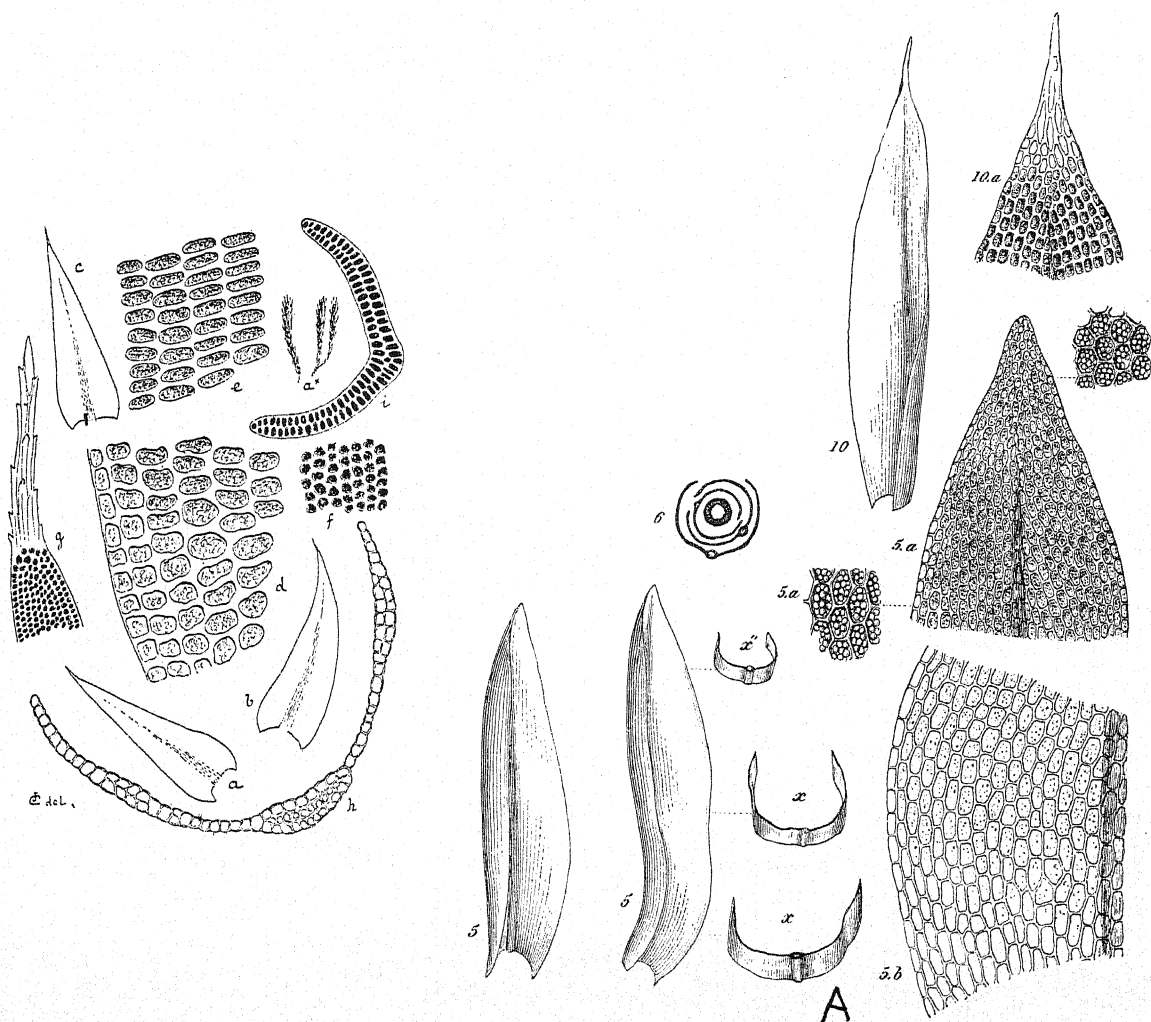
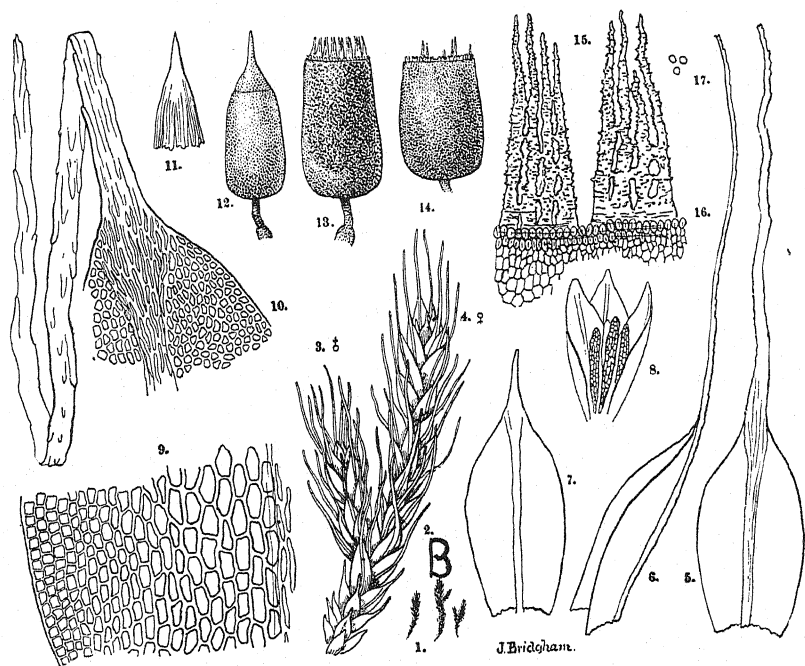


PLATE IV.



PLATE 5. (From Bryol. Eur. pl. 236) *Grimmia anodon*. 1, plant natural size; 1b, same enlarged; 2, 3, lower and upper leaves respectively; 3a, 3b, apex and base respectively of 3; 4, portion of plant showing inflorescence; 5, perigonal leaf; 6, antheridium; 7, perichaetial leaf; 8, 9, capsules; 11, old capsule; 10, calyptra; 12, operculum; 13, 14, mouth of capsule; 15, spores.

*Grimmia plagiopodia*. 1, 2, plants  $\times 1$ ; 2b, same magnified; 3, 4, fertile branches; 5, lower, 6, upper leaves; 5a, 6a, apices of same; 7, perichaetial leaves; 8, antheridial bud; 9, 10, perigonal leaves; 11, antheridia; 12, 13, 14, 16, 17, capsules; 15, calyptra; 18, peristome.

PLATE 6. Lower left, *Grimmia americana* (Bryologist 32: pl. 1). *A*, moist plant  $\times 3$ ; *B*, *C*, stem leaves  $\times 36$ ; *D*, outer perigonal leaf  $\times 36$ ; *E*, inner perigonal leaf  $\times 36$ ; *F*, capsule  $\times 36$ ; *G*, part of peristome  $\times 90$ ; *H*, inner perichaetial leaf  $\times 36$ ; *I*, calyptra and operculum  $\times 40$ ; *J*, one side of leaf base  $\times 180$ .

To the right and above, *Grimmia poecilostoma* (from Rev. Bryol. 28: pl. 5). 1, sterile plant; 3, perichaetial leaves; 4, perichaetial leaves and capsule; 5, 6, cross sections of leaf; 7 (number lacking), basal cells of a perichaetial leaf; 8, median basal cells of a leaf from the middle of the stem; 9, cells of the single layer from the middle of the leaf; 10, cells from the double layer near the leaf apex; 12, 13, capsules; 11, 14, 15, peristomes from different plants.

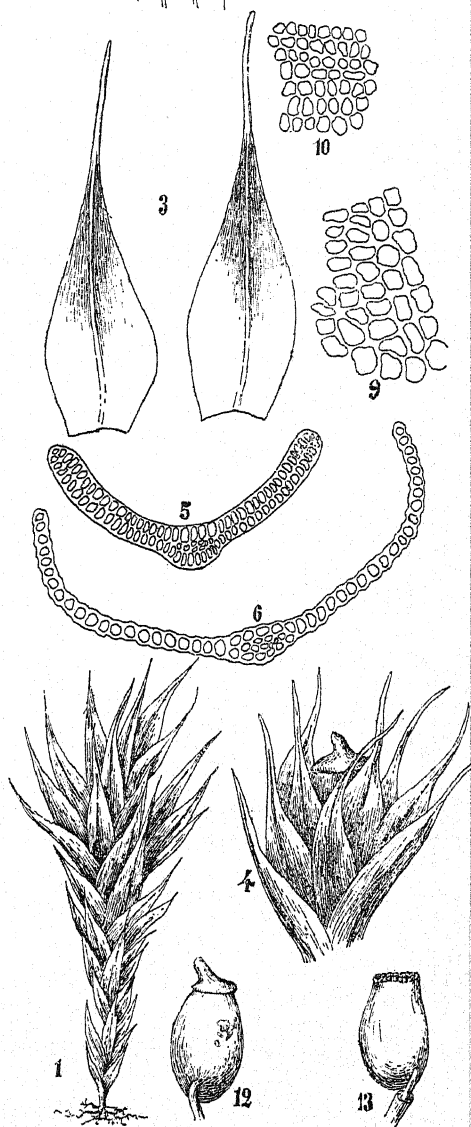
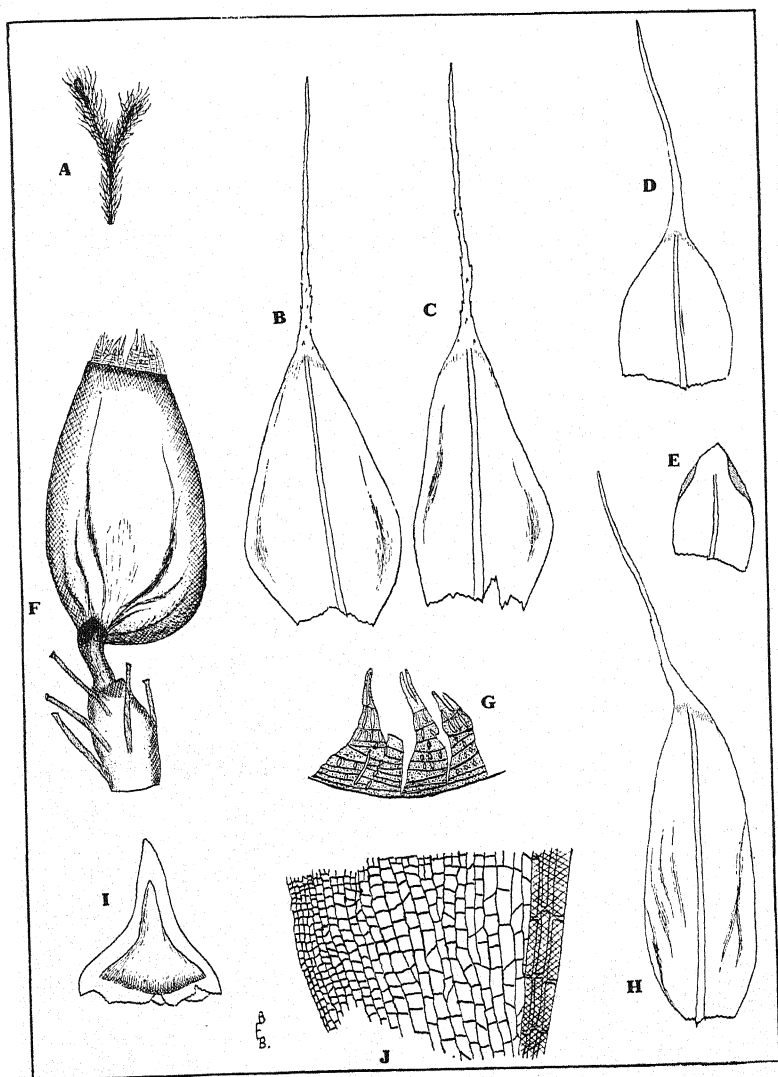
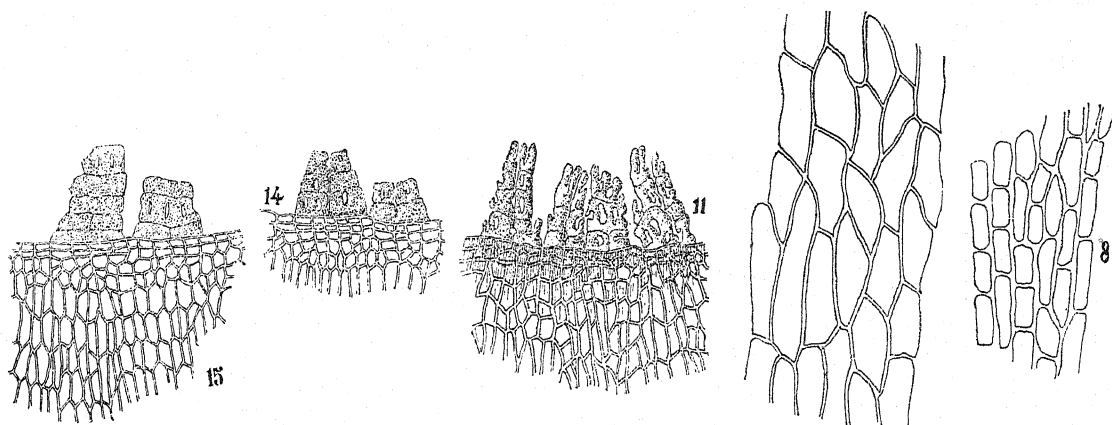
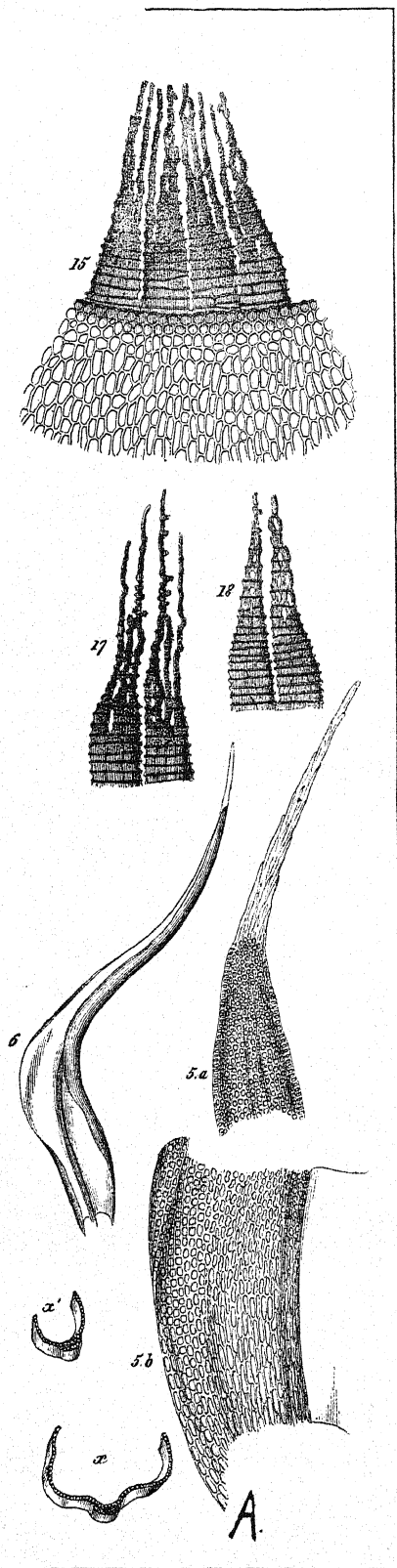


PLATE VI.



*G. commutata*

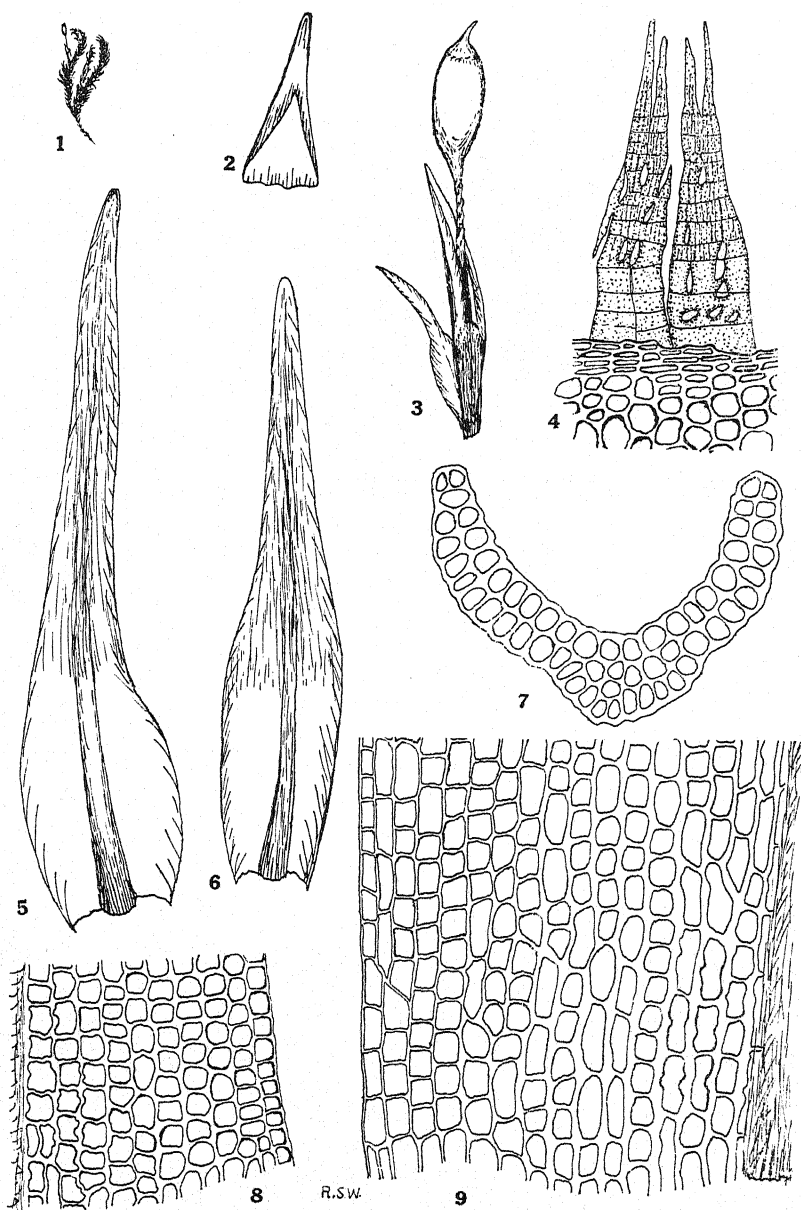


PLATE 7. A. *Grimmia commutata* (from Bryol. Eur. pl. 256). 6, leaf;  $x, x'$ , cross sections of the same; 5a and 5b, apical and basal leaf cells; 15, 17, 18, peristome teeth.

At the right *Grimmia brevirostris* (from Bryologist 23: pl. 3). 1, plant  $\times 1$ ; 2, calyptra  $\times 11$ ; 3, perichaetial leaves, capsule and seta  $\times 11$ ; 4, peristome teeth; 5, 6, stem leaves  $\times 35$ ; 7, cross section above middle of leaf  $\times 35$ ; 8, median leaf cells  $\times 270$ ; 9, basal leaf cells  $\times 270$ .

PLATE 8. A. *Grimmia elongata* (from Bryol. Eur. pl. 259). 4a, apex of lower leaf; 7b and 7a, base and apex respectively of upper leaf. By an oversight the other figures represent var. *patula* Bry. Eur. which has the leaves more widely spreading and longer pointed; capsules inclined and operculum apiculate.

Lower right, *Grimmia teretinervis* (from Bryologist 3: 21, figures). 1, plant  $\times 2.5$ ; 2, leaf  $\times 30$ ; 3-6, enlarged cells from apex, middle and base of leaf; 7-13, cross sections of leaves; 15-20, cross sections of leaves of *G. campestris*; 14, enlarged leaf of *G. Olneyi*; 21, cross section of leaf of *G. Olneyi* above the middle.

B. *Grimmia Moxleyi*. 1, plant  $\times 1$ ; 2, portion of fertile plant  $\times 5$ ; 3, lower leaf  $\times 20$ ; 4, two upper leaves  $\times 20$ ; 5, 6, 7, basal, apical and median leaf cells respectively  $\times 300$ ; 8, cross sections of leaf  $\times 60$ , with a marginal section  $\times 300$ ; 9, section of leaf with unusually revolute margins; 10, 11, outer and inner perichaetial leaf; 12, antheridial bud; 13, sporophytes  $\times 10$ ; 14, peristome teeth and annulus  $\times 30$ ; 15, portion of tooth  $\times 300$ . The plants drawn were from Holzinger's Musci Acrocarpi Bor.-Am. no. 600 in the herb. of A. J. G. They seem to vary from the plants described in the more revolute leaf margins, the less spinulose apices of the perichaetial leaves and the less gibbous capsules. Drawings by Seville Flowers.

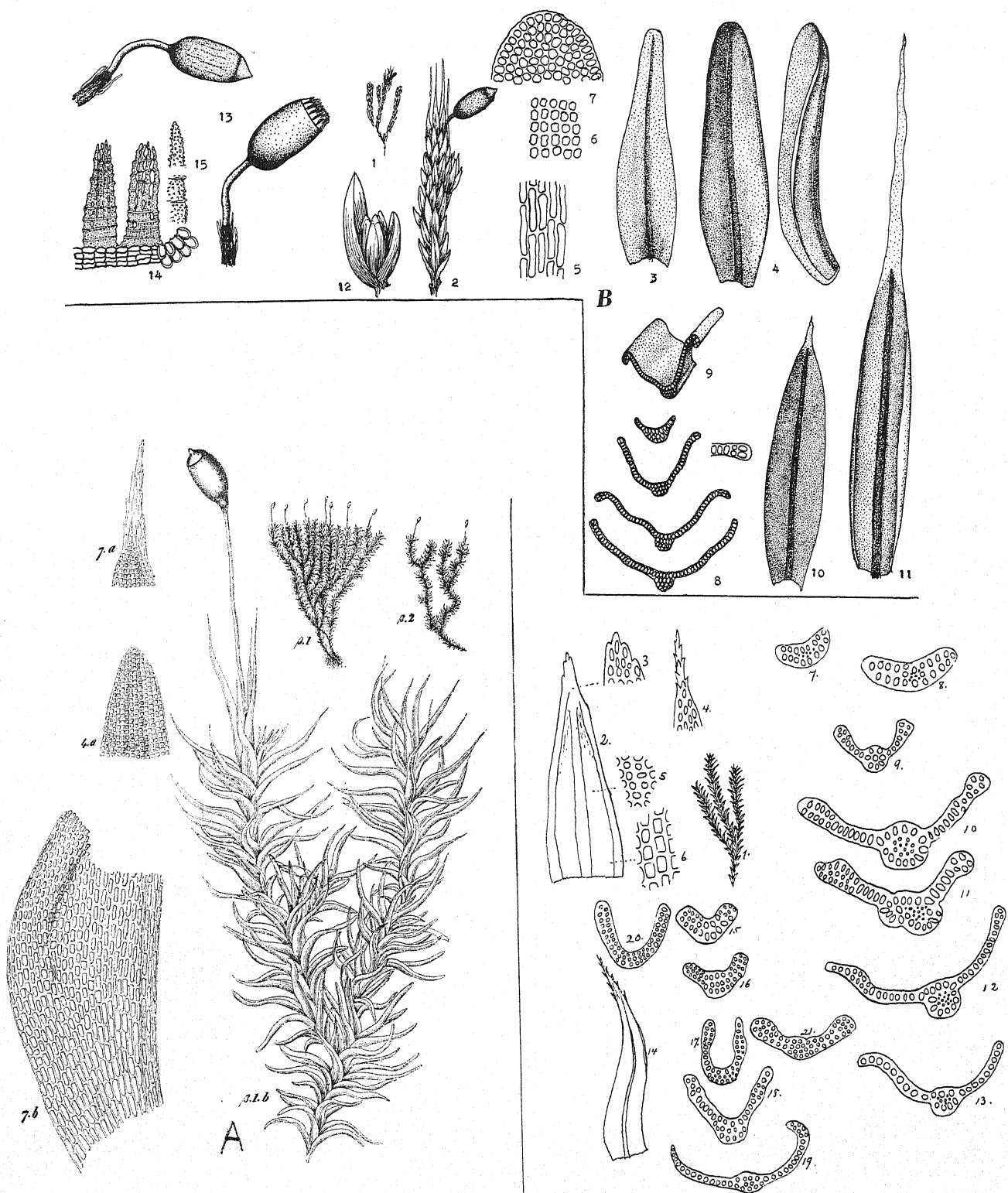


PLATE VIII.

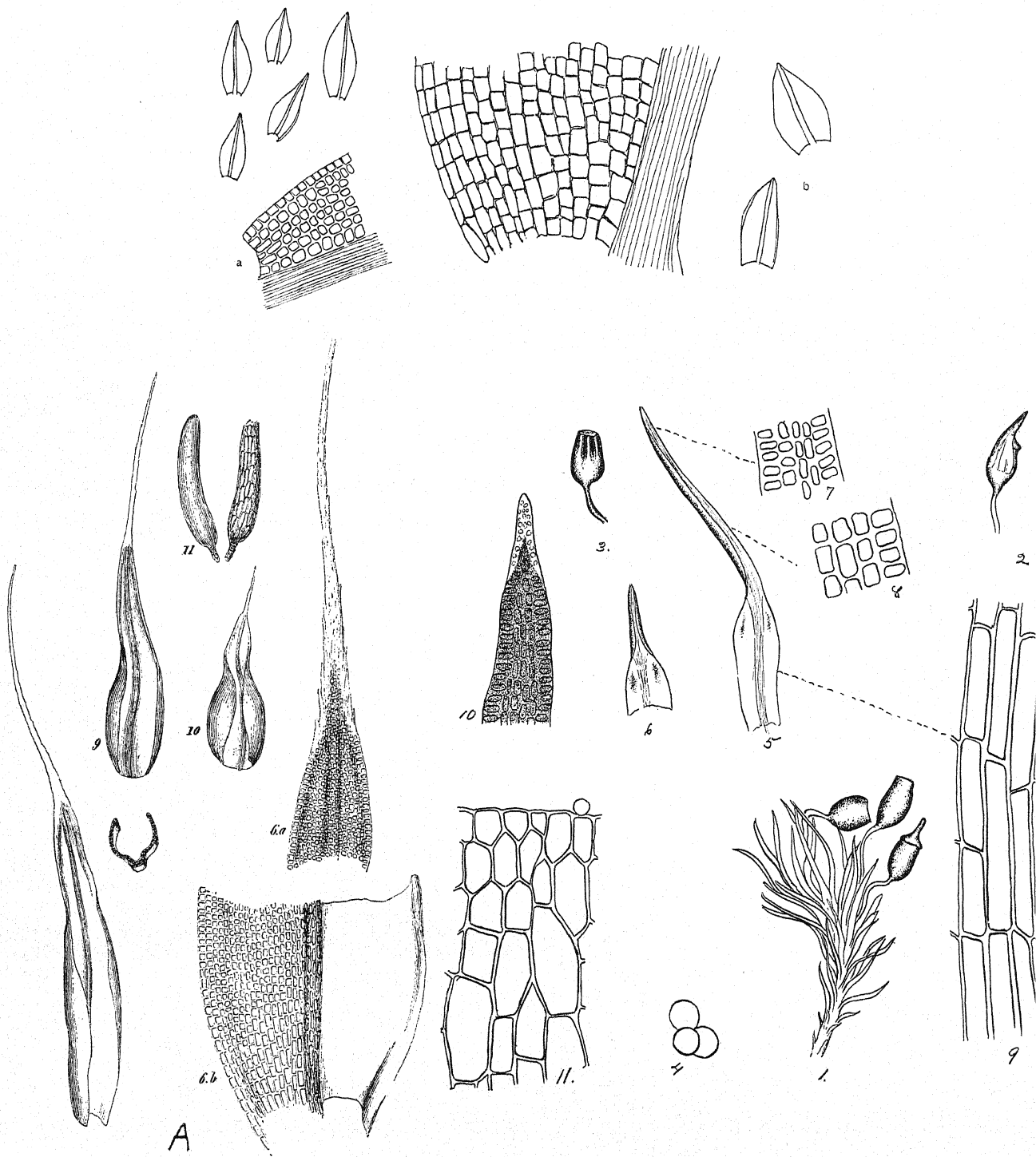


PLATE IX.

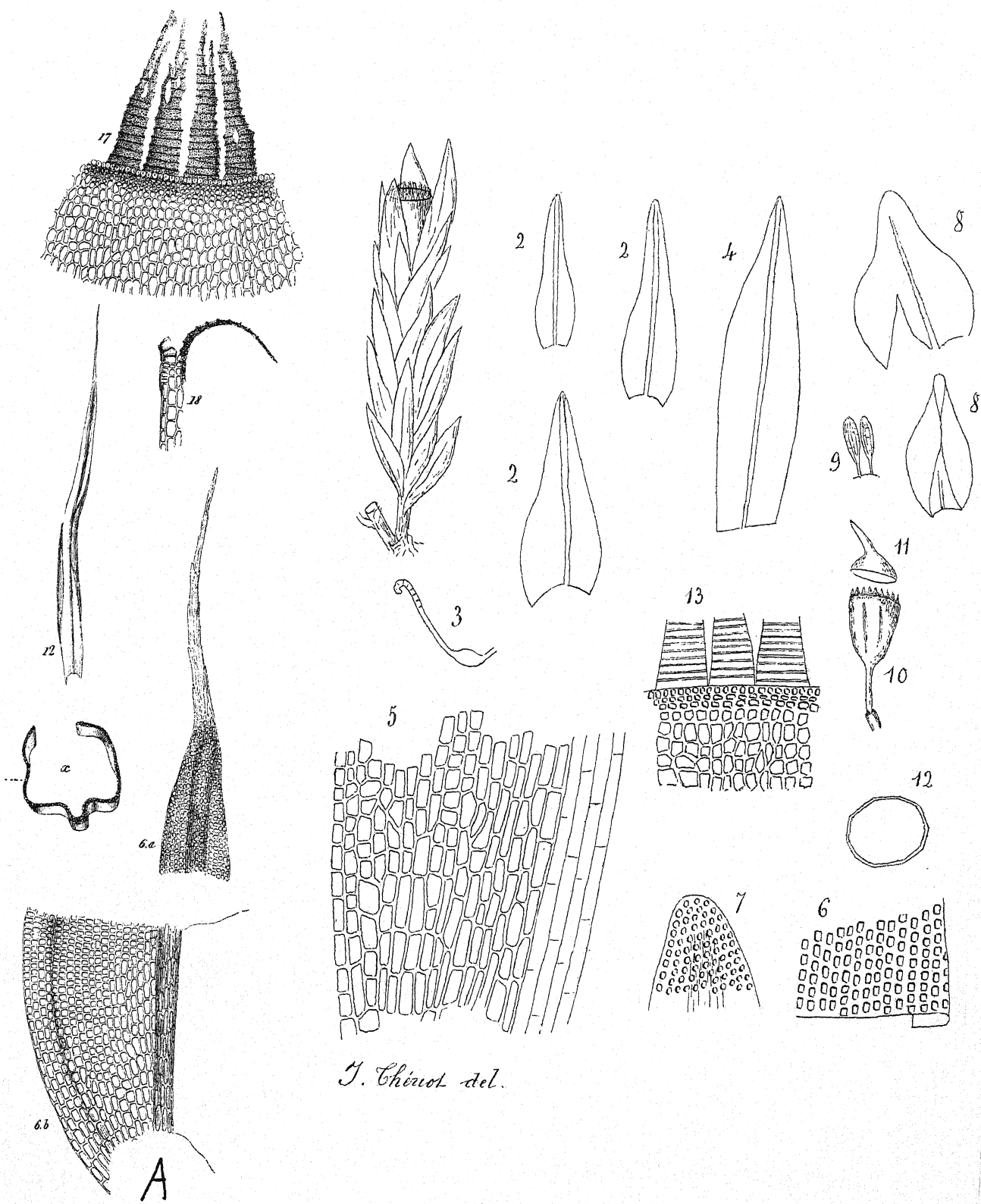
PLATE 9. A. *Grimmia montana* (from Bryol. Eur. pl. 250). At left, leaf and leaf section; 6a and 6b, leaf apex and leaf base; 9, 10, perigonal leaves; 11, antheridia.

Right. *Grimmia olympica* (from Bryologist 13: 58, pl. 7). 1, plant  $\times 12$ ; 2, 3, capsules  $\times 13$ ; 4, spores  $\times 530$ ; 5, upper leaf  $\times 34$ ; 6, lower leaf  $\times 34$ ; 7, 8, 9, cells from tip, middle, and base of leaf  $\times 405$ ; 10, tip of perichaetial leaf  $\times 200$ ; 11, exothecial cells near mouth of capsule  $\times 405$ .

Top. a, *Grimmia alpestris* var. *Holzingeri*; b, var. *Manniae*. Leaves of each  $\times 21.5$ , leaf cells  $\times 180$ . (From Bryologist 4: 24, f. 1.)

PLATE 10. A. *Grimmia alpestris* (from Bryol. Eur. *pl.* 251). *a*, cross section of leaf; *6a* and *6b*, apex and base of leaf respectively; 12, inner perichaetial leaf; 17, 18, portions of peristome.

Right. *Grimmia Dupretii* (from Bryologist 10: 62, *pl.* 8). 1, plant  $\times 10$ ; 2, leaves  $\times 32$ ; 3, cross section of leaf  $\times 95$ ; 4, perichaetial leaf  $\times 32$ ; 5, 6, 7, basal, median and apical leaf cells respectively  $\times 208$ ; 8, perigonal leaves  $\times 32$ ; 10, 11, capsule and lid dry  $\times 18$ ; 13, part of peristome  $\times 95$ . According to the author all figures are reduced about  $\frac{1}{5}$ .



*J. Chénol del.*

*G. alpestris*

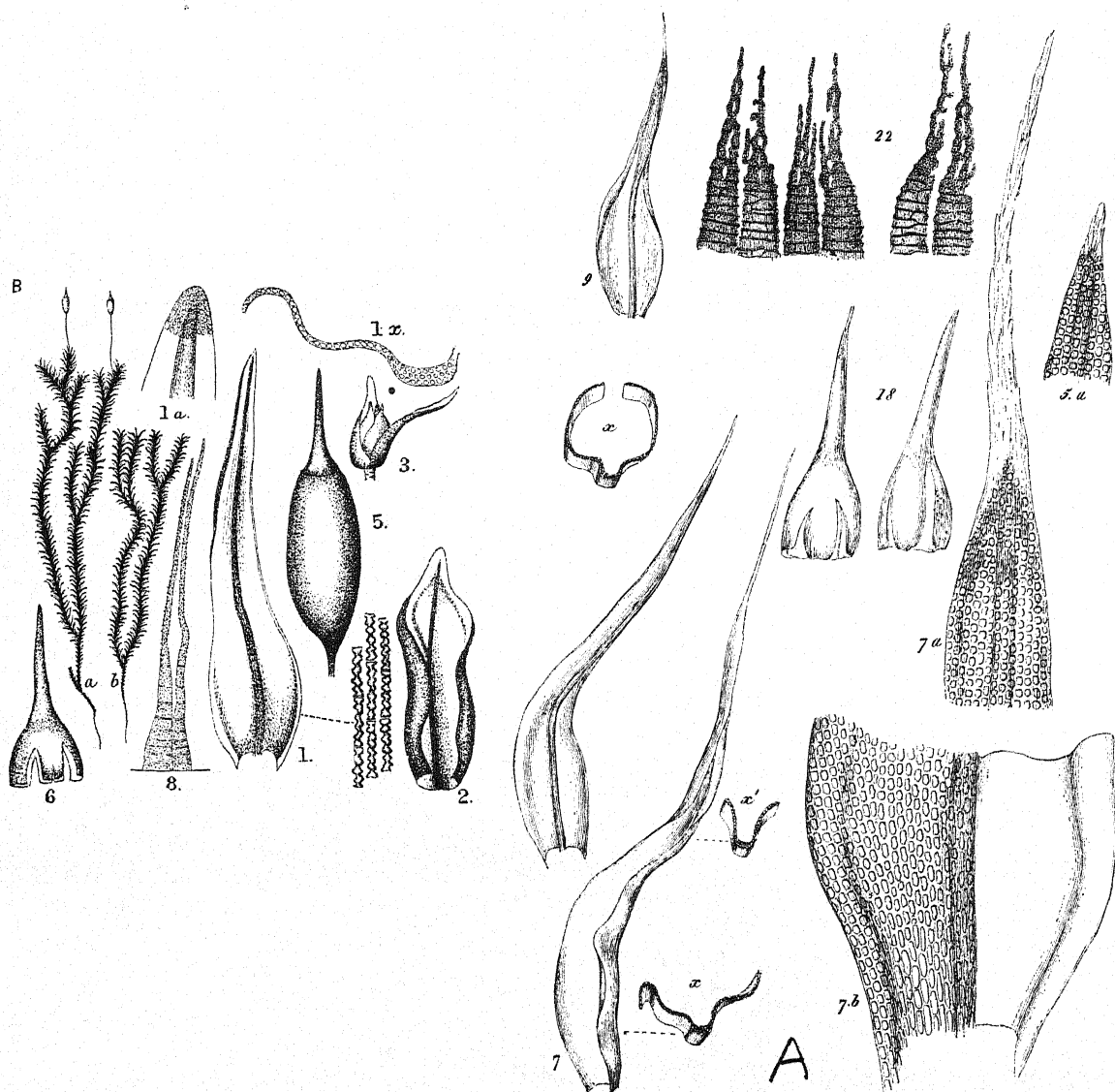
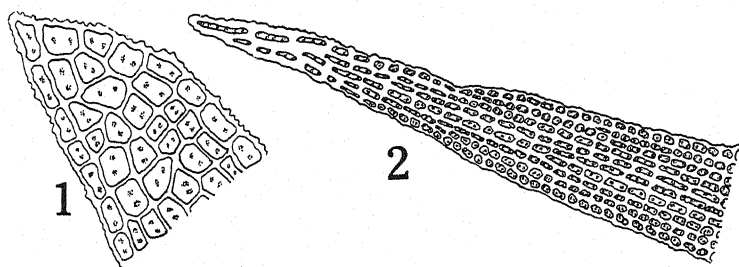


PLATE XI.

PLATE II. A. *Grimmia ovalis* (from Bryol. Eur. *pl.* 254). 6, 7, leaves; x, cross section of perichaetial leaf; 7a, 7b, apical and basal areolation of 7; 5a, apex of lower leaf; 9, perigonal leaf; 18, calyptrae; 22, peristome teeth.

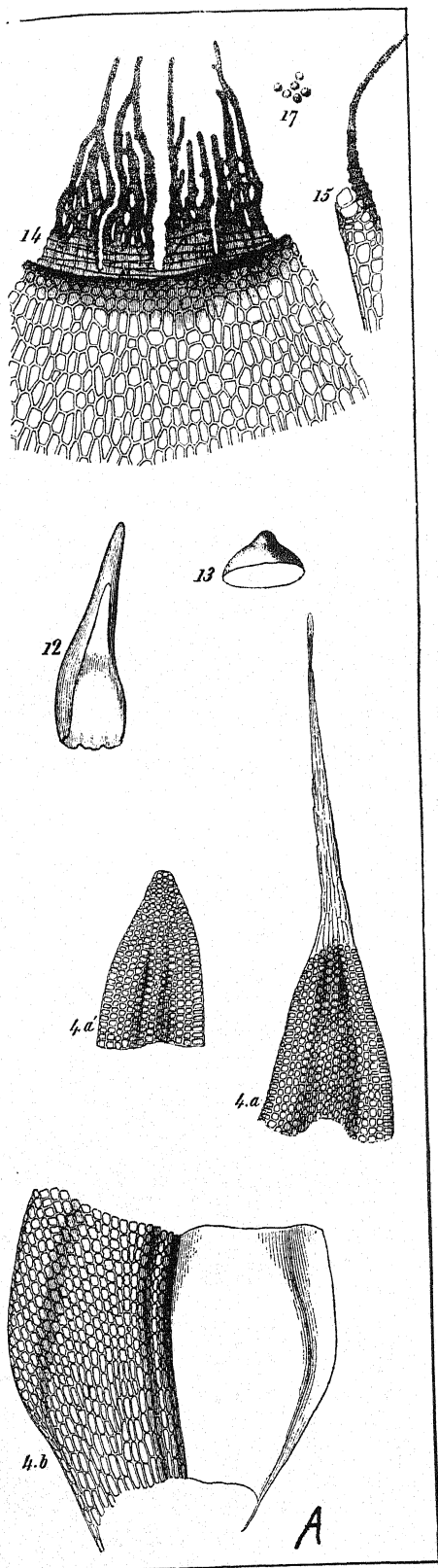
B. *Racomitrium aquaticum* (from Braithwaite, Brit. Moss. Fl. *pl.* 51B). a, female plant; b, male plant; 1, leaf; 1x, cross section of leaf; 1a, apex; 2, perichaetial leaf; 3, antheridial bud; 5, capsule; 6, calyptra; 8, tooth of peristome.

Upper. *Racomitrium canescens epilosum* (from Bryologist 21: *pl.* 9). 1, tip of rather blunt leaf  $\times$  400; 2, tip of rather pointed leaf  $\times$  200.

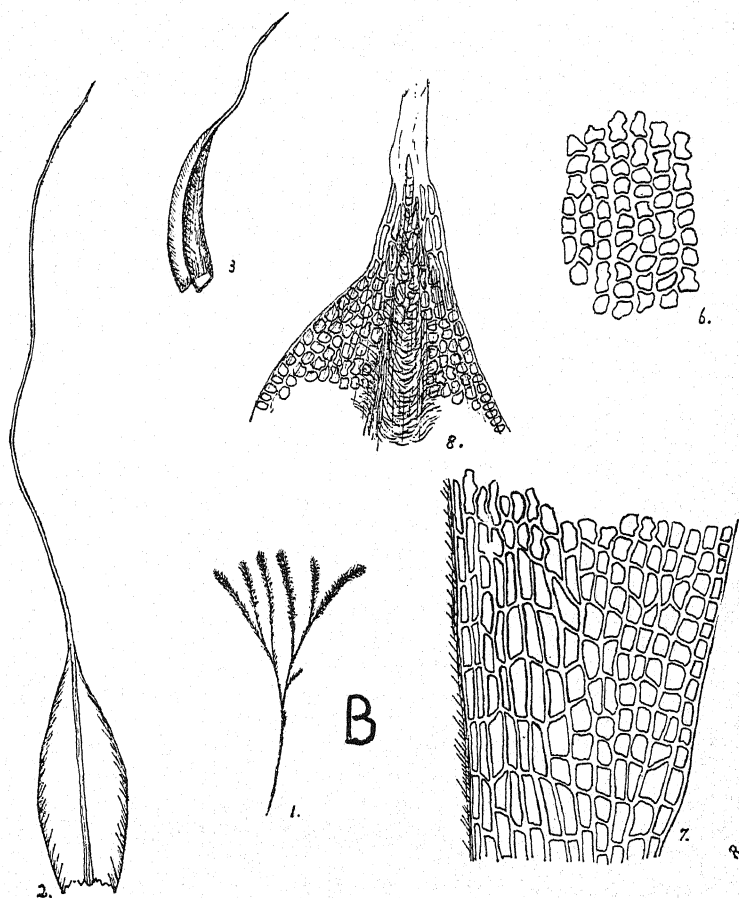
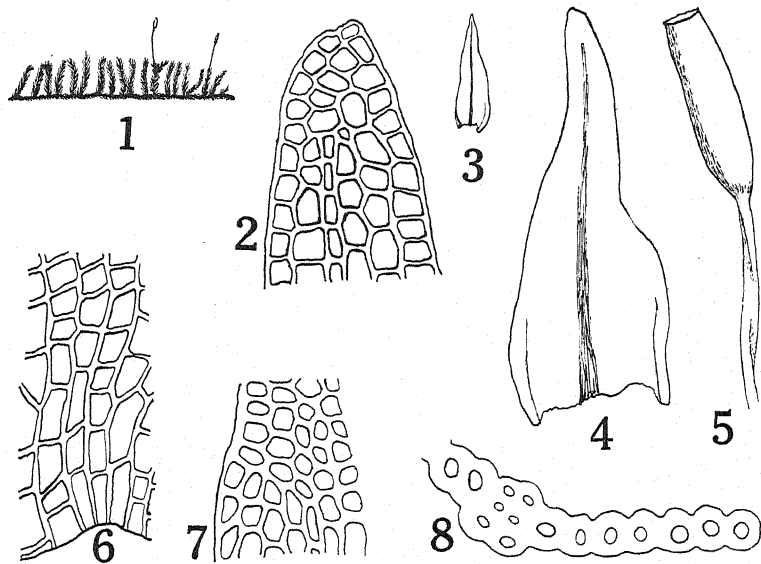
PLATE 12. A. *Grimmia orbicularis* (from Bryol. Eur. pl. 240) 4a, 4b, apex and base of leaf; 4a', probably apex of lower leaf; 12, calyptra; 13, capsule lid; 14, 15, portions of peristome.

B. *Grimmia Brittoniae* (from Bull. Torr. Bot. Club 27: pl. 19). 1, plant about natural size; 2, upper leaf  $\times 35$ ; 3, lower stem leaf  $\times 35$ ; 6, median cells  $\times 350$ ; 7, basal cells; 8, apex of leaf from upper side  $\times 175$ .

Upper right. *Racomitrium cyclodictyon* (from Bryologist 21: pl. 1). 1, plant  $\times 1$ ; 2, leaf tip  $\times 400$ ; 3, leaf  $\times 17$ ; 4, leaf  $\times 90$ ; 5, capsule  $\times 17$ ; 6, cells of leaf base  $\times 400$ ; 7, median leaf cells  $\times 400$ ; 8, cross section of leaf near the tip  $\times 400$ .



*G. orbicularis*



*GRIMMIA BRITTONIAE.*

R.S.W.

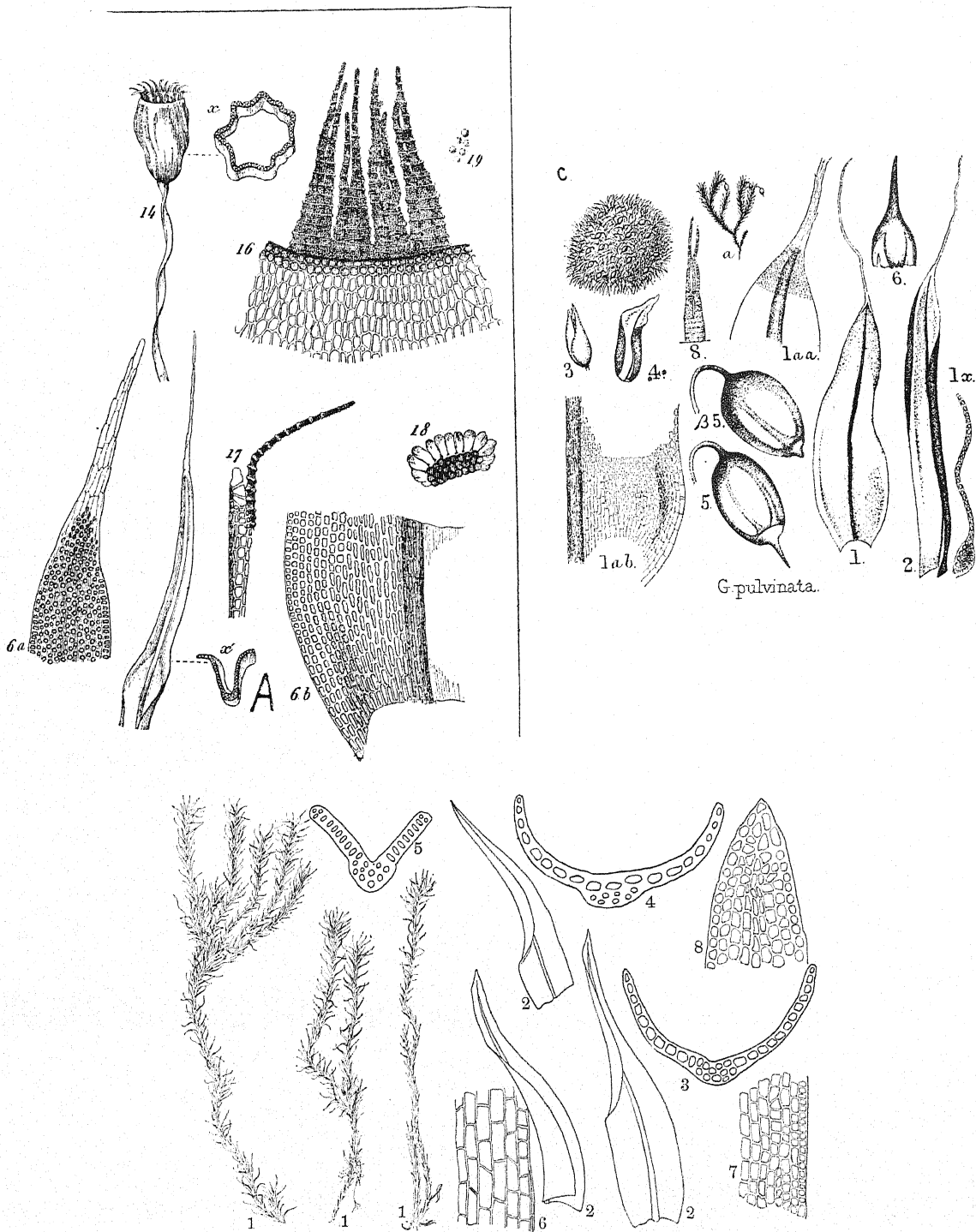


PLATE XIII.

PLATE 13. A. *Grimmia funalis* (from Bryol. Eur. pl. 242). x', upper leaf and cross section of same; 6a, 6b, apex and base of leaf; 14, capsule; 16, 17, peristome teeth; 18, annulus.

C. *Grimmia pulvinata* (from Braithwaite, Brit. Moss Fl. pl. 48C). For detailed description see description of Pl. 11, B.  $\beta$ 5, capsule of var. *obiusa*.

Below. *Grimmia Flettii* (from Bryologist 7: pl. 5). 1, 1, 1, plants moist  $\times 3$ ; 2, 2, 2, leaves  $\times 10$ ; 3, 4, 5, cross sections of leaf; 6, 7, 8, leaf cells from base, middle and apex respectively.

PLATE 14. A. *Grimmia trichophylla* (from Bryol. Eur. pl. 244). 5a, 5b, apex and base of leaf; 7, antheridial bud; 8, perigonal leaf; 9, perichaetial leaves and capsule; 10, perichaetial leaves; 12, capsule with calyptra; 14, calyptra; 13, empty deoperculate capsule; 15, 16, 17, 18, peristome teeth; 19, annulus.

B. *Grimmia incurva* (from Braithwaite, Brit. Moss Fl. pl. 47B). For description of figures see description of Pl. 11, B.

C. *Grimmia trichophylla*, var. *Muehlenbeckii* (from Bryol. Eur. pl. 243).

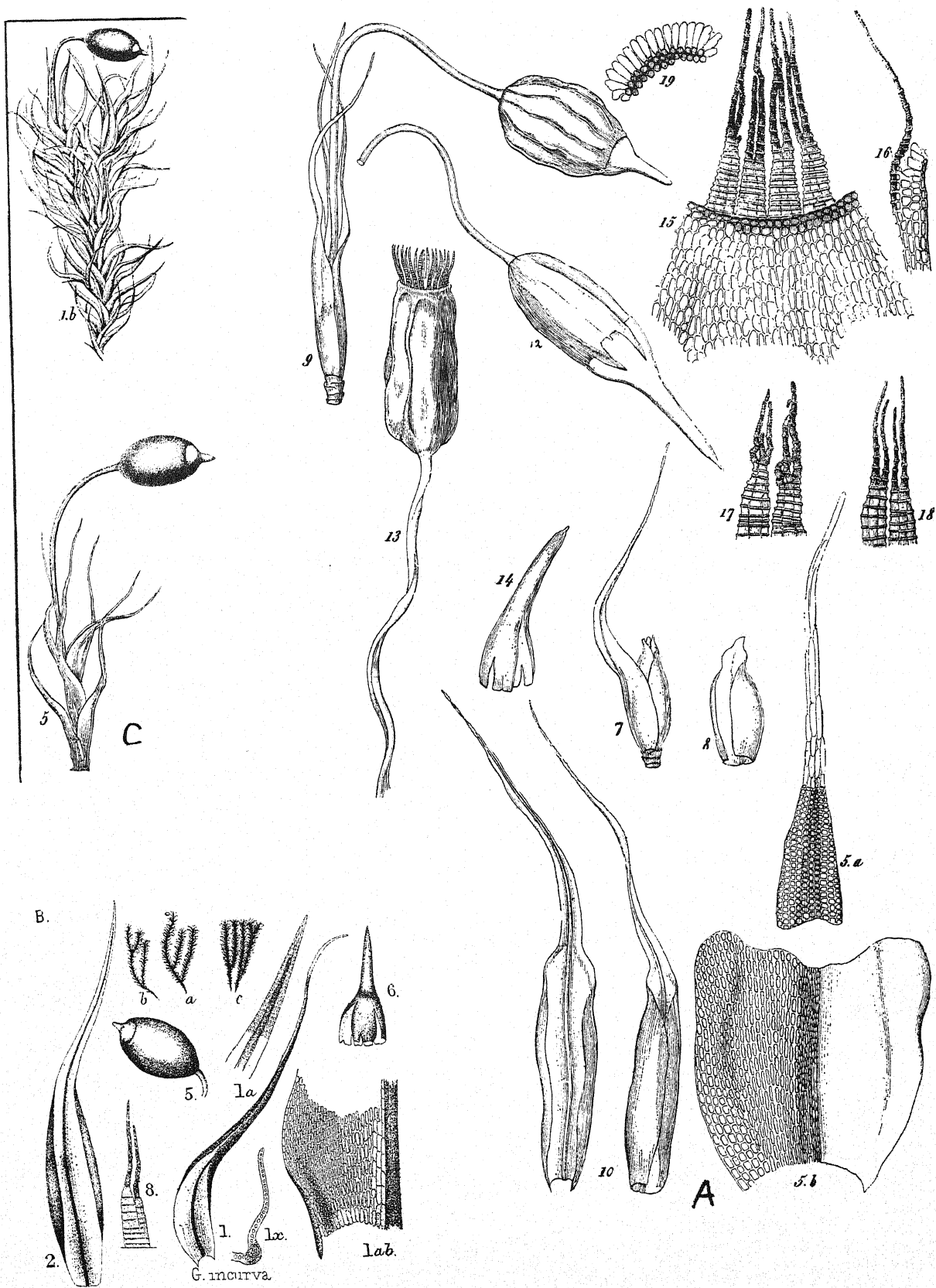


PLATE XIV.

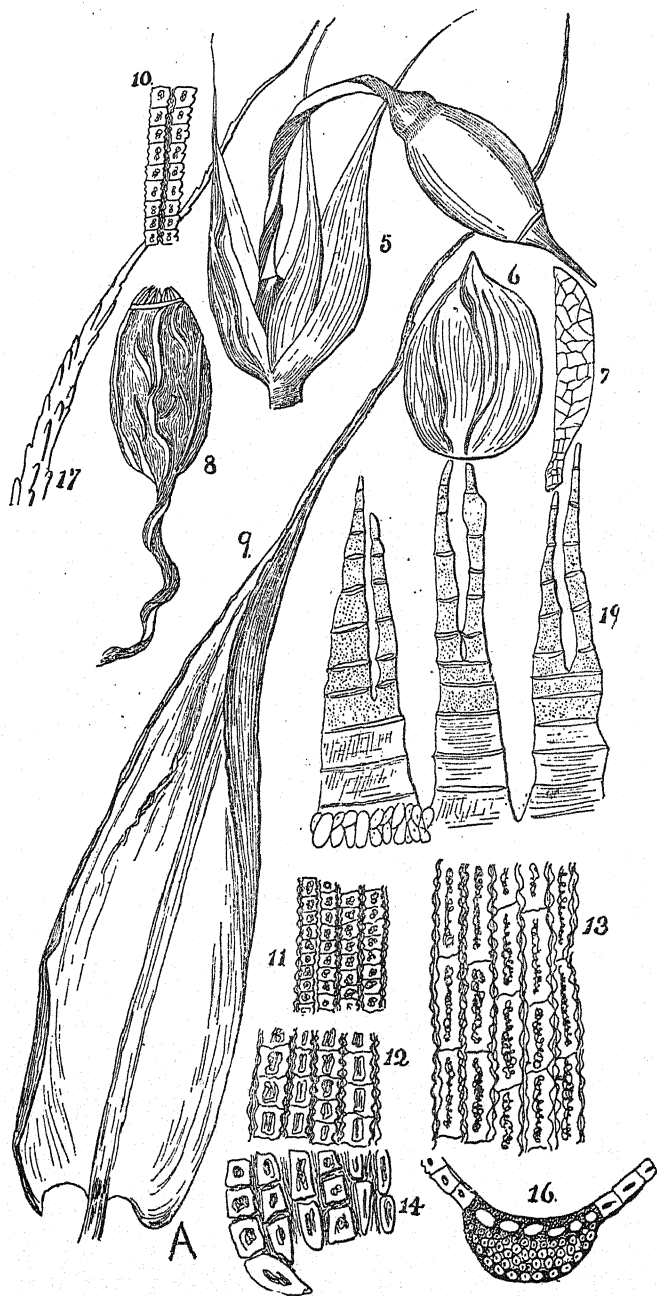
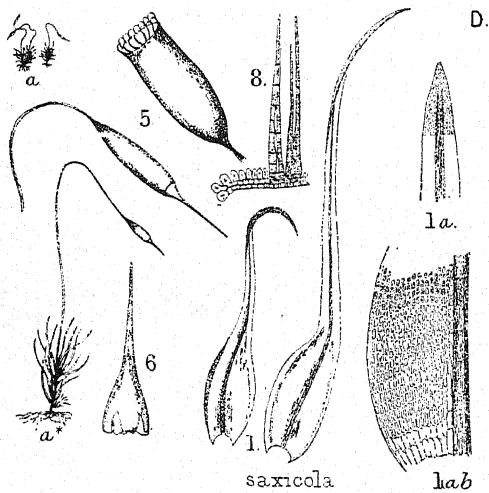
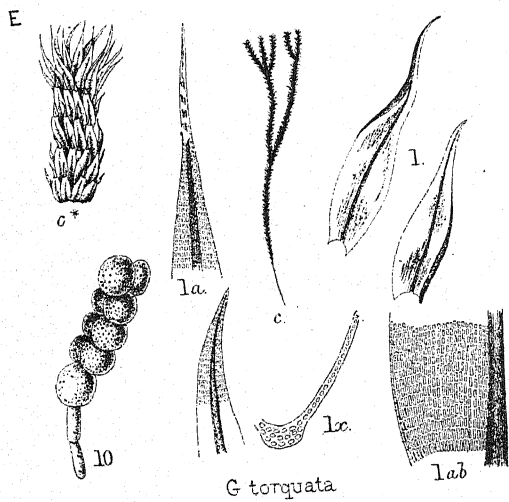
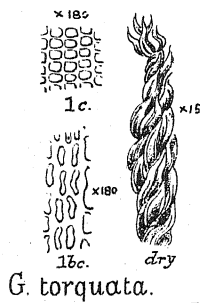


PLATE XV.

PLATE 15. *A. Grimmia Leibergii* (from Bull. Torr. Bot. Club, 20: pl. 144). 5, capsule and perichaetial leaves; 6, inner perigonal leaf; 7, antheridium; 8, old dry capsule; 9, stem leaf; 10, bit of leaf margin from near the apex; 11, upper leaf cells; 12, median leaf cells; 13, basal cells  $\times 450$ ; 14, cells of basal angles; 16, section of costa from near the leaf middle; 17, hair point of leaf; 19, three peristome teeth with fragment of annulus.

*D. Campylostelium saxicola* (from Braithwaite, Brit. Moss. Fl. 2: pl. 53).

*E. Grimmia torquata* (l. c. pl. 47).

Figures are lettered the same in both *D* and *E*. *a*, fertile plant; *a\** same magnified; *c*, sterile plant; *c\**, portion of same magnified; 1, leaves; 1x, cross section of leaf; 1a, leaf apex; 1ab, leaf base showing cells; 5, capsule; 6, calyptra; 8, peristome tooth; 10, gemmae.

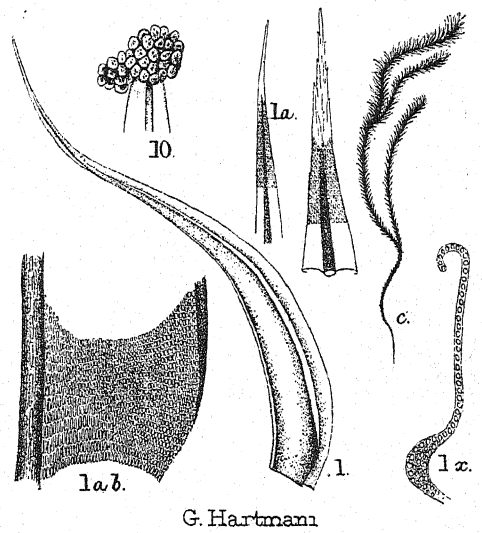
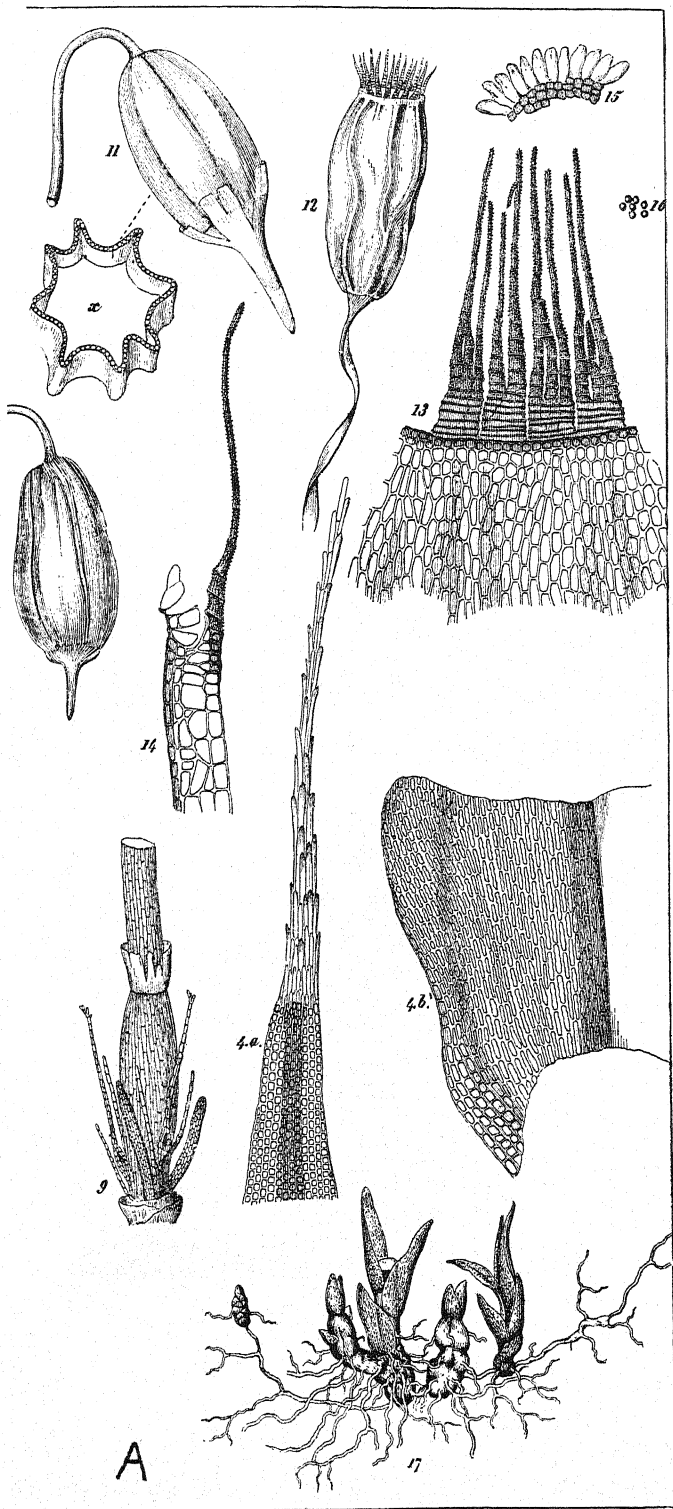
Upper left. *Grimmia torquata* (from Dixon, Handb. Brit. Mosses (Ed. 2) pl. 21 K. Portion of stem dry, basal and apical leaf cells.

PLATE 16. *A. Grimmia decipiens* (from Bryol. Eur. *pl.* 247). 4a, 4b, apex and base respectively of leaf; 11, capsules; 12, dry and empty capsule; 13, portion of peristome; 14, side view of peristome tooth and annulus; 15, annulus; 17, lower part of stem with rhizoids, tubercles and young plants.

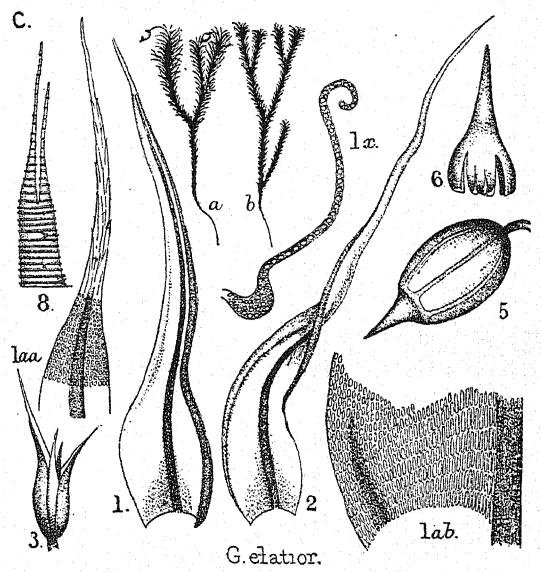
*C. Grimmia elatior* (from Braithwaite, Brit. Moss Fl. 2: *pl.* 49C).

*F. Grimmia Hartmani* (Braithwaite, l. c. *pl.* 48F).

Explanations of details of *C* & *F* as in *D* & *E*, plate 15.



G. Hartmann



G. elatior.

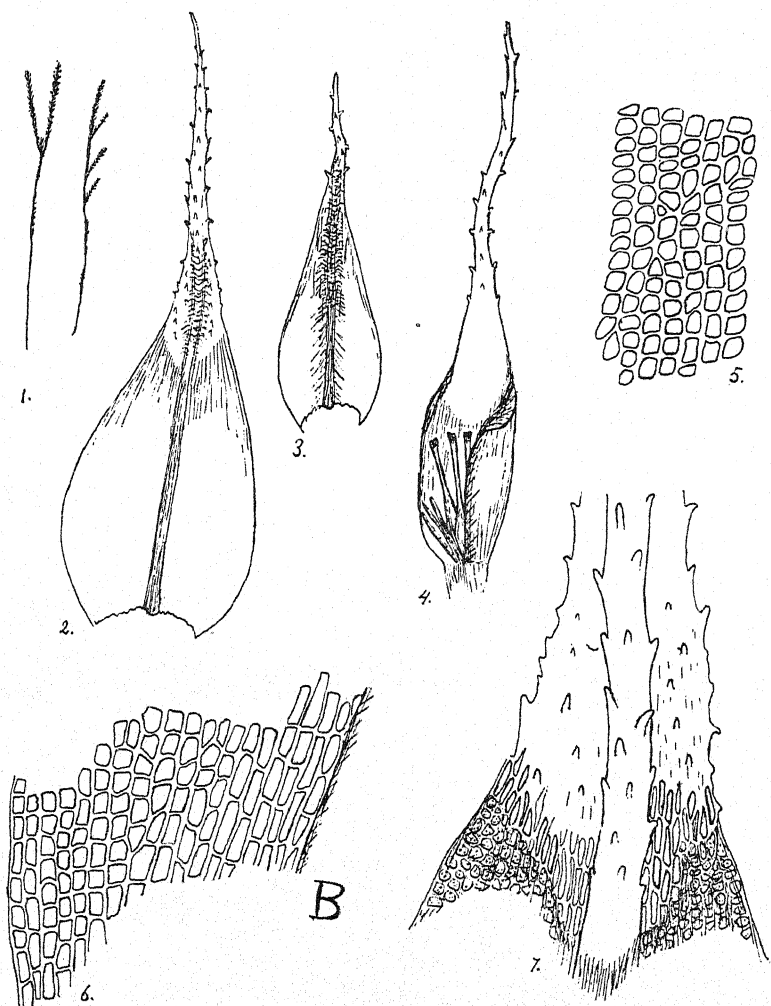
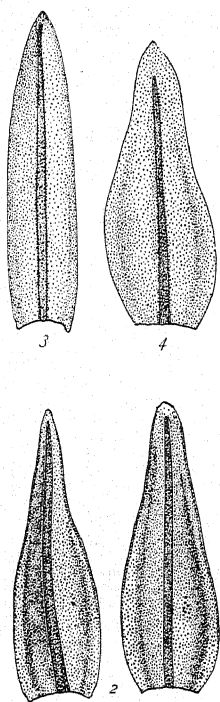
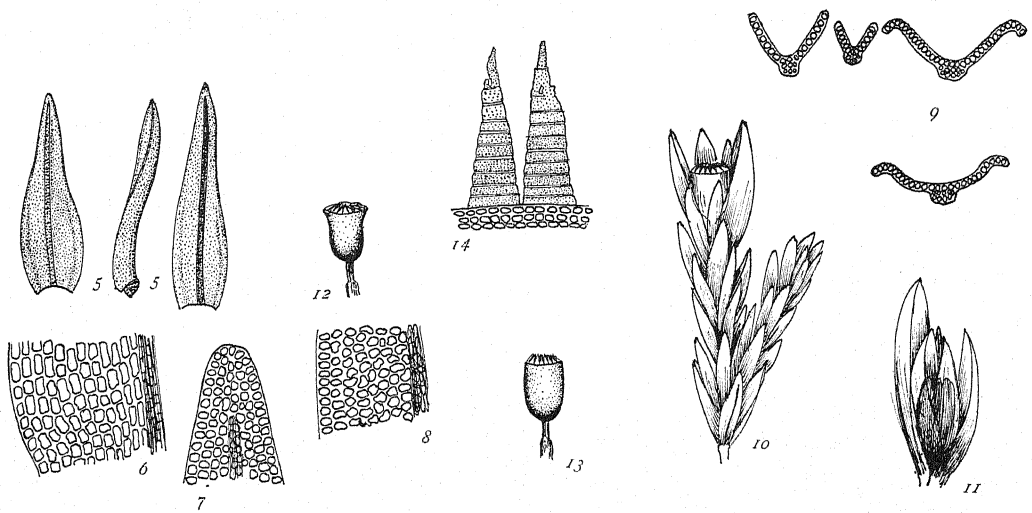


PLATE 17. A. *Grimmia atricha*. 1, plant  $\times 1$ ; 2, upper leaves  $\times 50$ ; 3, upper comal leaf  $\times 50$ ; 4, inner perichaetial leaf  $\times 50$ ; 5, lower leaves  $\times 50$ ; 6, basal leaf cells  $\times 300$ ; 7, apical cells  $\times 300$ ; 8, median cells  $\times 300$ ; 9, cross sections of leaf  $\times 65$ ; 10, portion of fertile branch; 11, antheridial bud; 12, dry capsule  $\times 10$ ; 13, moist capsule  $\times 10$ ; 14, peristome teeth  $\times 150$ . Drawings by Seville Flowers.

B. *Grimmia tenuicaulis*. 1, plants about natural size; 2, upper stem leaf  $\times 35$ ; 3, lower stem leaf  $\times 35$ ; 4, part of perichaetium; 5, median cells  $\times 350$ ; 6, basal cells  $\times 350$ ; 7, apex of leaf from below  $\times 175$ . (From Bull. Torr. Bot. Club, 27: pl. 20.)

PLATE 18. Lower, *Scouleria aquatica* (from E.-P. (Ed. 2) 10: fig. 251). *A*, fruiting plant  $\times 1$ ; *B*, fruiting branch enlarged; *C*, stem leaf  $\times 12$ ; *D*, leaf apex  $\times 100$ ; *E*, leaf base  $\times 100$ ; *F*, peristome  $\times 175$ .

Upper, *Scouleria marginata* (from Bull. Torr. Bot. Club, 22: pl. 227). 2, capsule with perichaetial leaves; 3, capsule after dehiscence; 4, 5, leaves; 6, basal cells of leaf; 7, apical cells of leaf; 8, marginal cells from the middle of the leaf; 10 (at the top) cross section of leaf showing thickened margins.

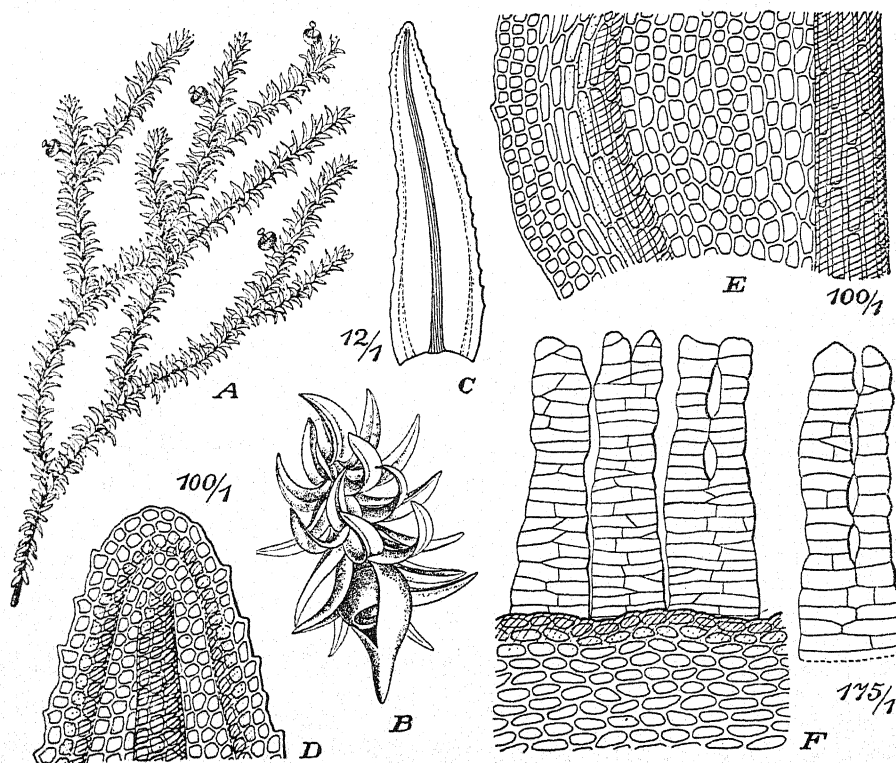
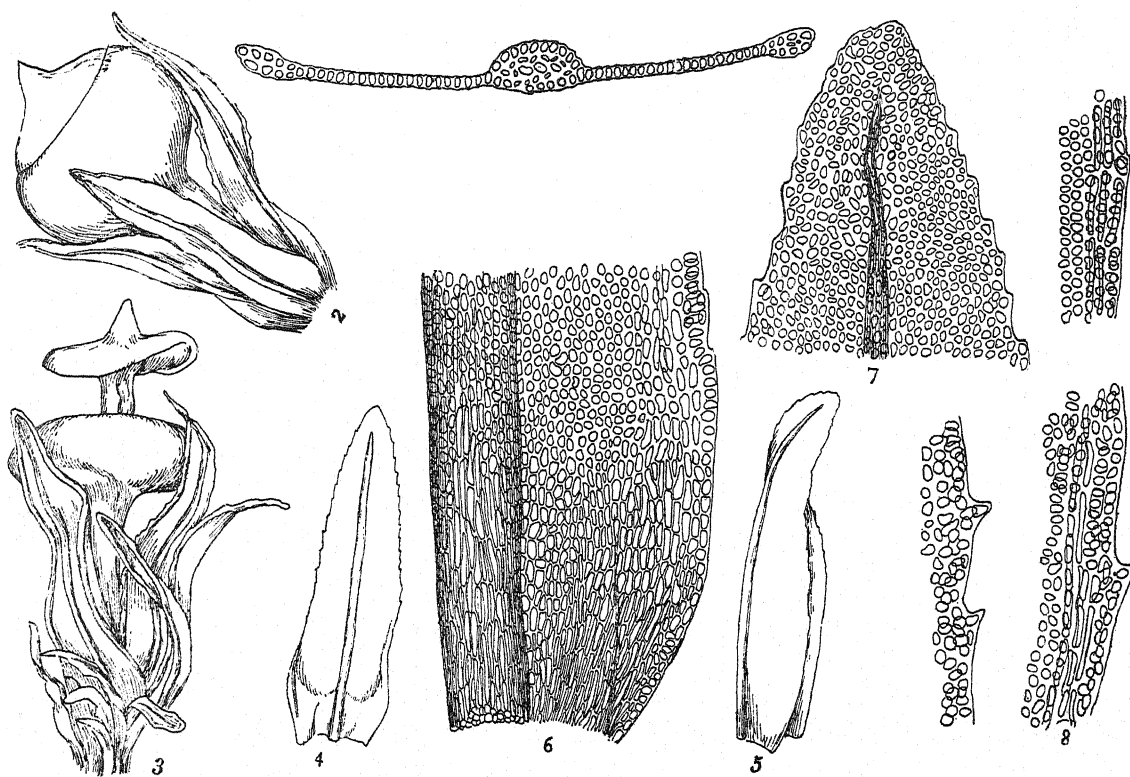


PLATE XVIII.

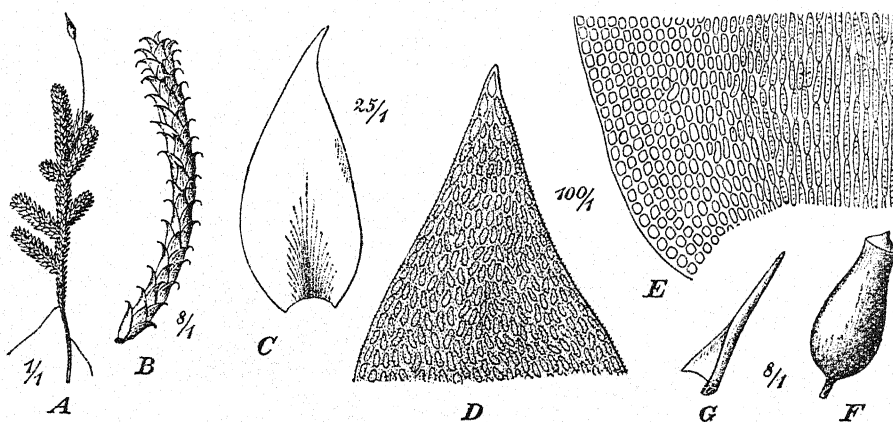
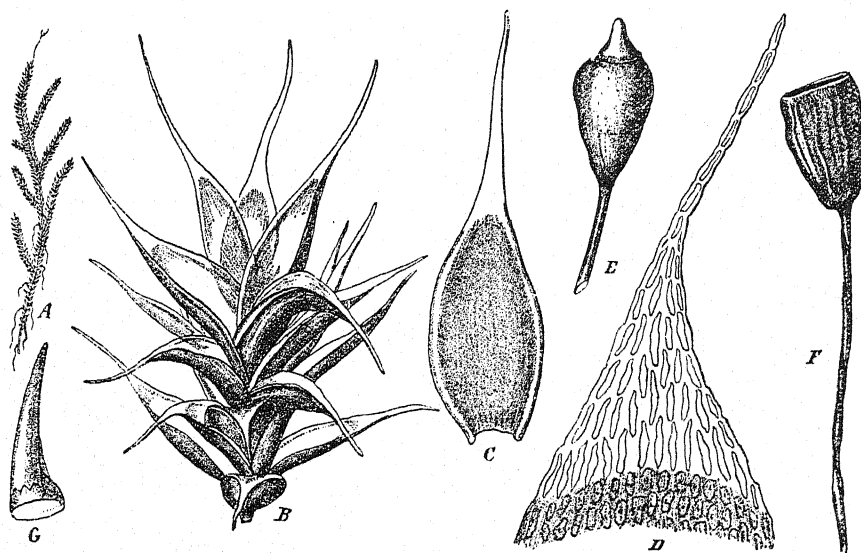


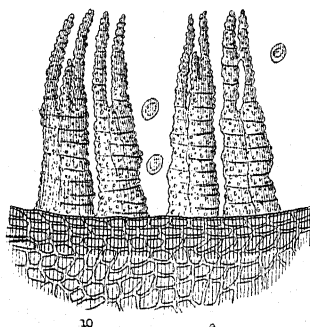
PLATE XIX.

PLATE 19. Above, *Braunia californica* (E.-P. (Ed. 2) 11:f. 482, after Sullivant). *A*, fruiting plant  $\times$  1; *B*, portion of stem magnified; *C*, stem leaf; *D*, leaf apex; *E*, capsule; *F*, dry and empty capsule; *G*, lid with calyptra.

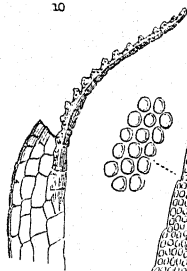
Below, *Braunia secunda* (from E.-P. (Ed. 2) 11:fig. 484). *A*, fruiting plant; *B*, portion of stem, dry; *C*, stem leaf; *D*, leaf apex; *E*, portion of leaf base; *F*, capsule; *G*, calyptra.

PLATE 20. A. *Ptychomitrium Drummondii* (from Sullivan, Icones Musc. pl. 40). 7, base and 8, apex of stem leaf; 10, 11, peristome teeth.

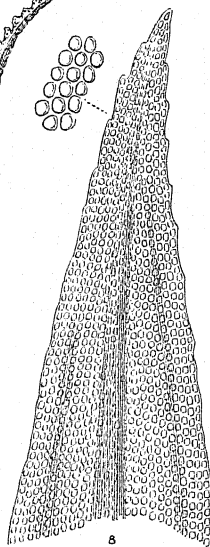
At right, *Ptychomitrium Leibergii* (from Bryologist 9: 79, pl. 7). 1, plant  $\times 2$ ; 2, same  $\times 22$ ; 3, leaf; 4, 5, leaf base and apex respectively; 6, archegonial bud; 7, calyptra; 8, spores; 9, peristome teeth.



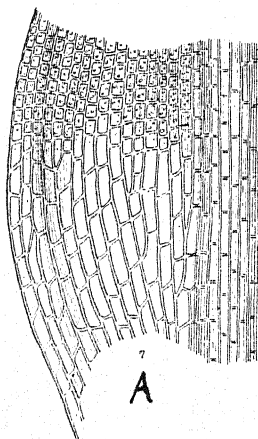
10



11



8



A



FIG. 1.

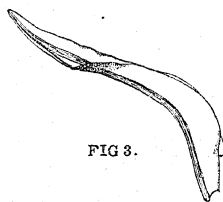


FIG. 3.



FIG. 6.

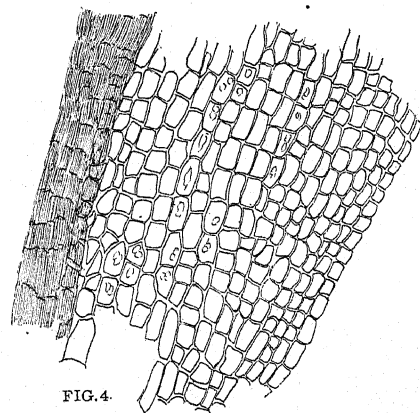


FIG. 4.



FIG. 7.

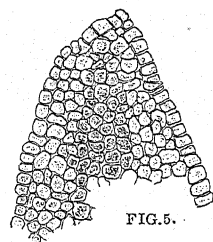


FIG. 5.



FIG. 8.



FIG. 2.

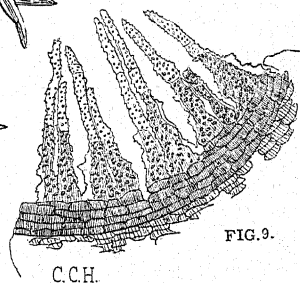


FIG. 9.

C.C.H.

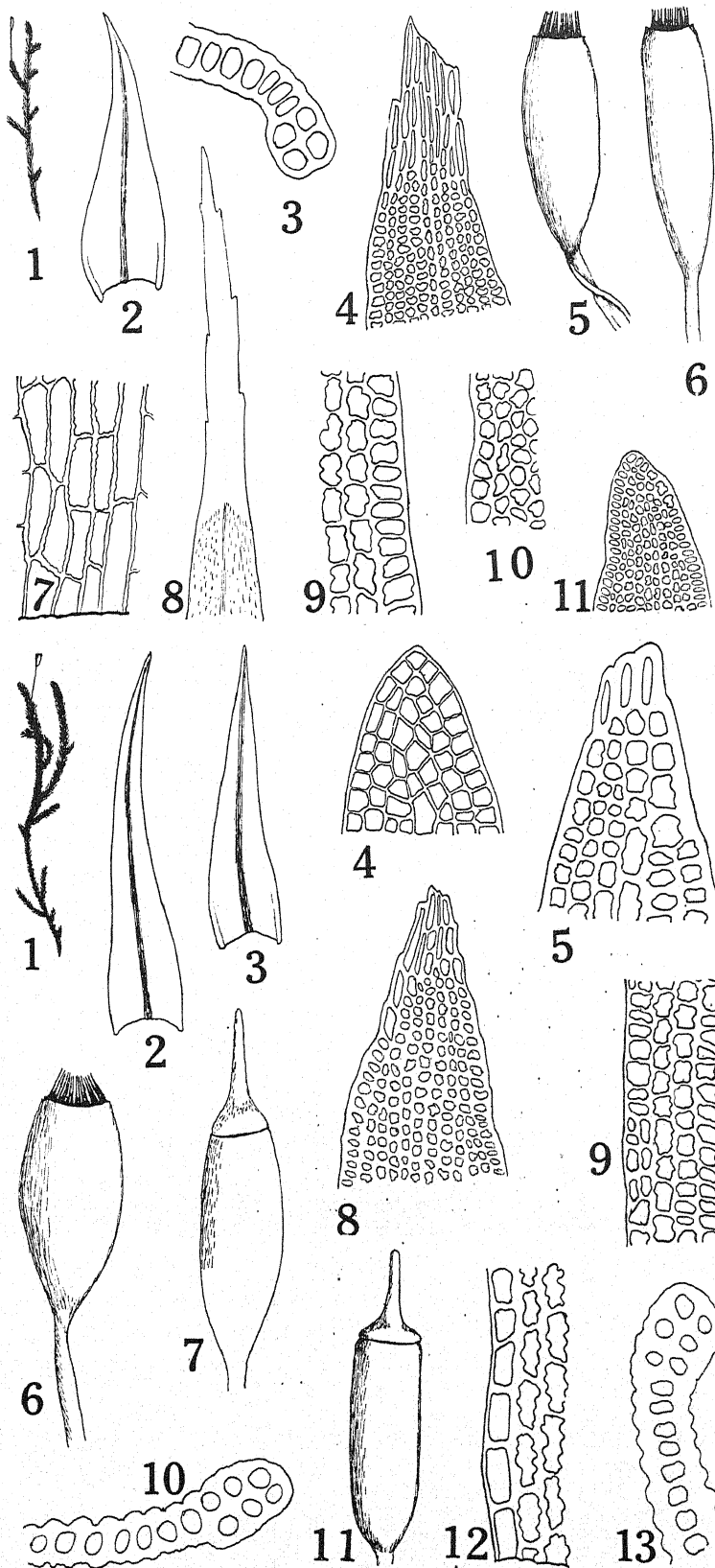


PLATE XXI.

PLATE 21. Below, *Racomitrium Macounii* (from Bryologist 21: pl. 6). 1, plant  $\times 1$ ; 2, 3, leaves  $\times 17$ ; 4, leaf tip having no hyaline point  $\times 400$ ; 5, leaf tip having only three hyaline cells  $\times 400$ ; 6, 7, 11, capsules  $\times 17$ ; 8, leaf tip with typical hyaline point  $\times 200$ ; 9, cells of leaf middle  $\times 400$ ; 10, cross section of leaf margin near tip  $\times 400$ ; 13, same from upper portion of leaf  $\times 550$ ; 12, cells of leaf base  $\times 17$ .

Above, *Racomitrium affine* (from Bryologist 21: pl. 6). 1, plant  $\times 1$ ; 2, leaf  $\times 17$ ; 3, cross section of leaf margin near apex  $\times 550$ ; 4, leaf tip  $\times 200$ ; 5, 6, capsules  $\times 17$ ; 7, cells near leaf base  $\times 400$ ; 8, leaf tip with a long hyaline point  $\times 100$ ; 9, cells of the leaf middle  $\times 400$ ; 10, cells near leaf tip  $\times 400$ ; 11, muticous leaf tip  $\times 200$ .

PLATE 22. Below, *Racomitrium heterostichum* (from Bryologist, 21: pl. 2). 1, plant  $\times 1$ ; 2, median leaf cells  $\times 400$ ; 3, leaf  $\times 17$ ; 4, leaf tip  $\times 200$ ; 5, capsule  $\times 17$ ; 6, cross section of upper leaf margin  $\times 550$ .

Above, *Racomitrium depressum* (from Bryologist 20: pl. 23). 1, plant  $\times 1$ ; 2, 3, 4, 5, leaves  $\times 17$ ; 6, capsule  $\times 17$ ; 7, cross section of a part of a leaf  $\times 550$ ; 8, basal leaf cells  $\times 400$ ; 9, median leaf cells  $\times 400$ ; 10, leaf tip  $\times 400$ .

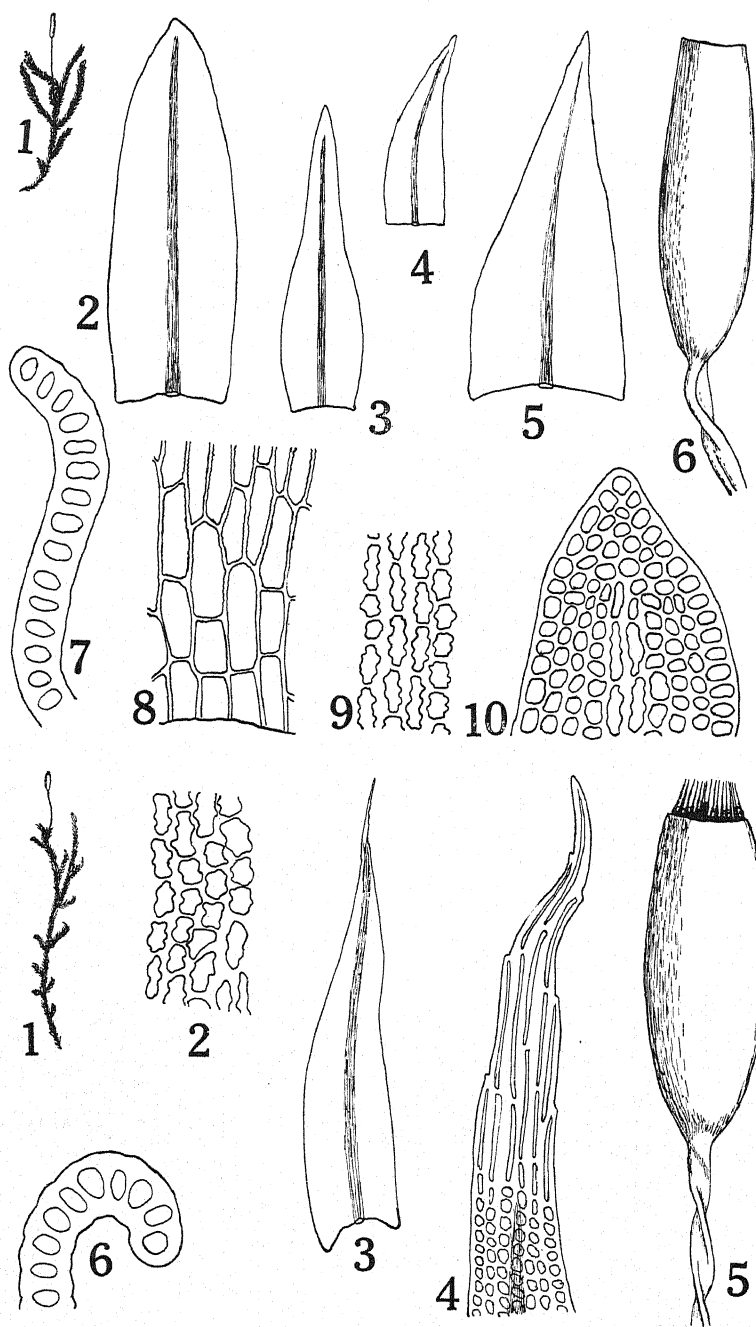


PLATE XXII.

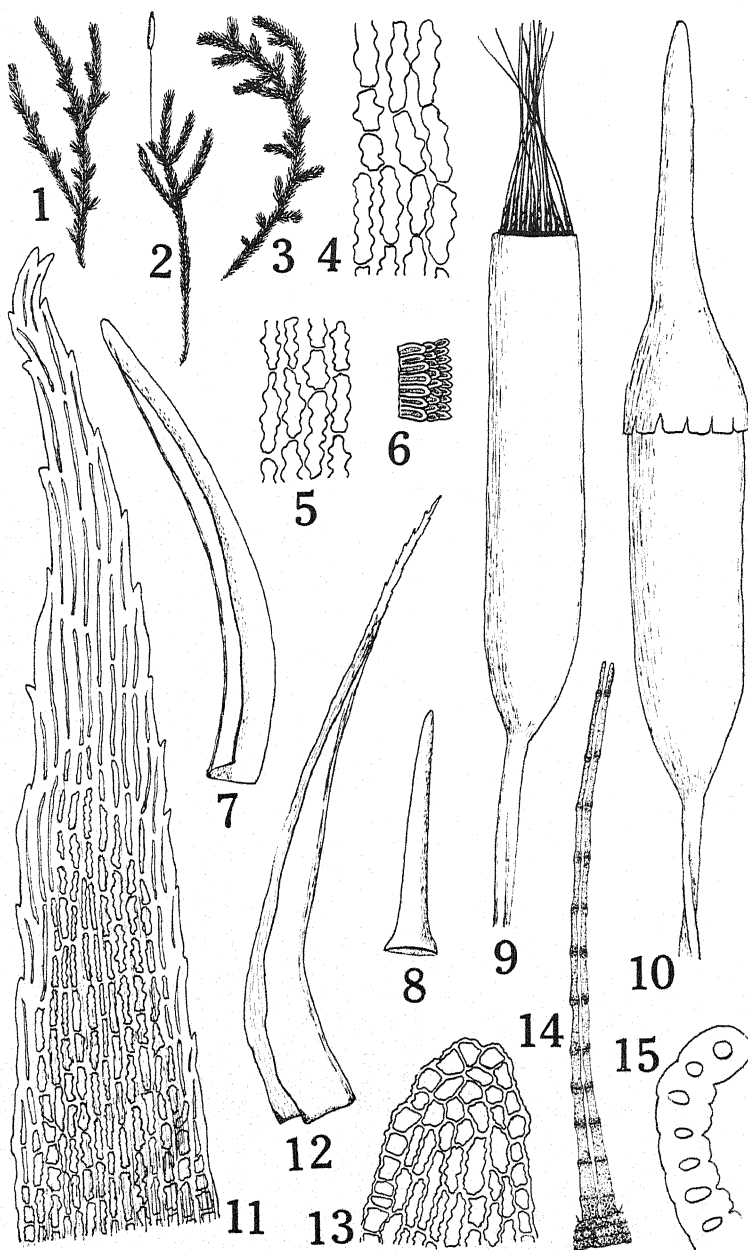


PLATE XXIII.

PLATE 23. *Racomitrium varium* (from Bryologist 21: pl. 7). 1, 2, 3, plants  $\times 1$ ; 4, basal leaf cells  $\times 400$ ; 5, median leaf cells  $\times 400$ ; 6, annulus  $\times 105$ ; 7, 12, leaves  $\times 25$ ; 8, lid  $\times 17$ ; 9, 10, capsules  $\times 17$ ; 11, leaf tip  $\times 300$ ; 13, leaf tip  $\times 400$ ; 14, split tooth of peristome  $\times 400$ ; 15, cross section of leaf margin near tip  $\times 400$ .

PLATE 24. A. *Racomitrium patens* (from Bryol. Eur. pl. 246). 4, leaves with cross sections; 4a, 4b, apex and base of leaf respectively; 4b' basal cells near the costa; 8, archegonial and antheridial buds; 14, two peristome teeth.

Left, *Grimmia arizonae* (from the Bryologist, 27: pl. 9, as *G. santa-ritae*). 1-3, plants  $\times \frac{3}{4}$ ; 4, stem leaf  $\times 15$ ; 5, perichaetial leaf  $\times 15$ ; 6, part of plant  $\times 8$ ; 7, leaf apex  $\times 75$ ; 8, marginal basal cells  $\times 300$ ; 9, basal cells near costa  $\times 300$ ; 10, capsule  $\times 8$ ; 11, two peristome teeth with annulus  $\times 75$ ; 12, cross section of upper part of leaf  $\times 75$ ; 13, calyptra and lid  $\times 15$ .

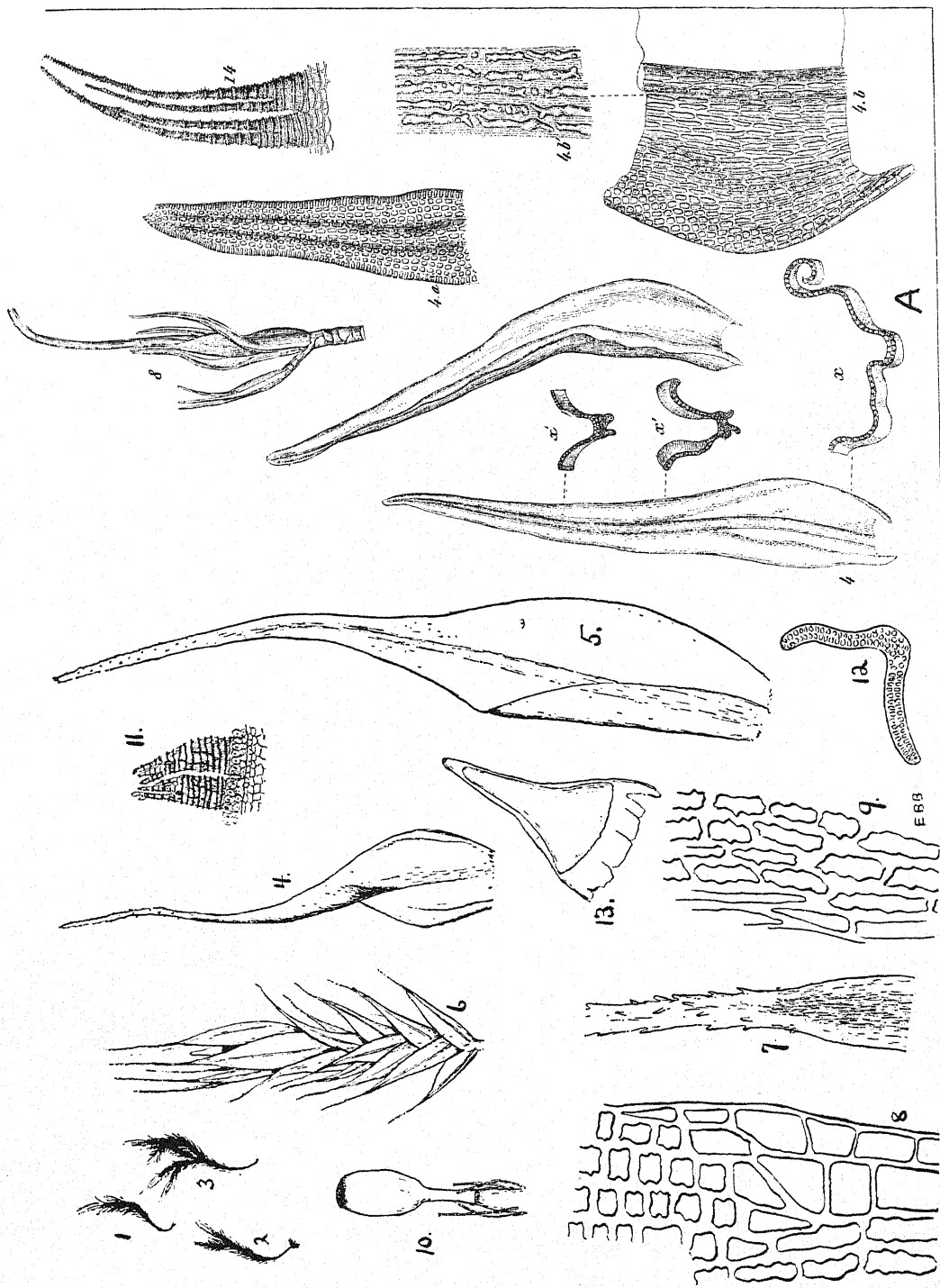


PLATE XXIV.

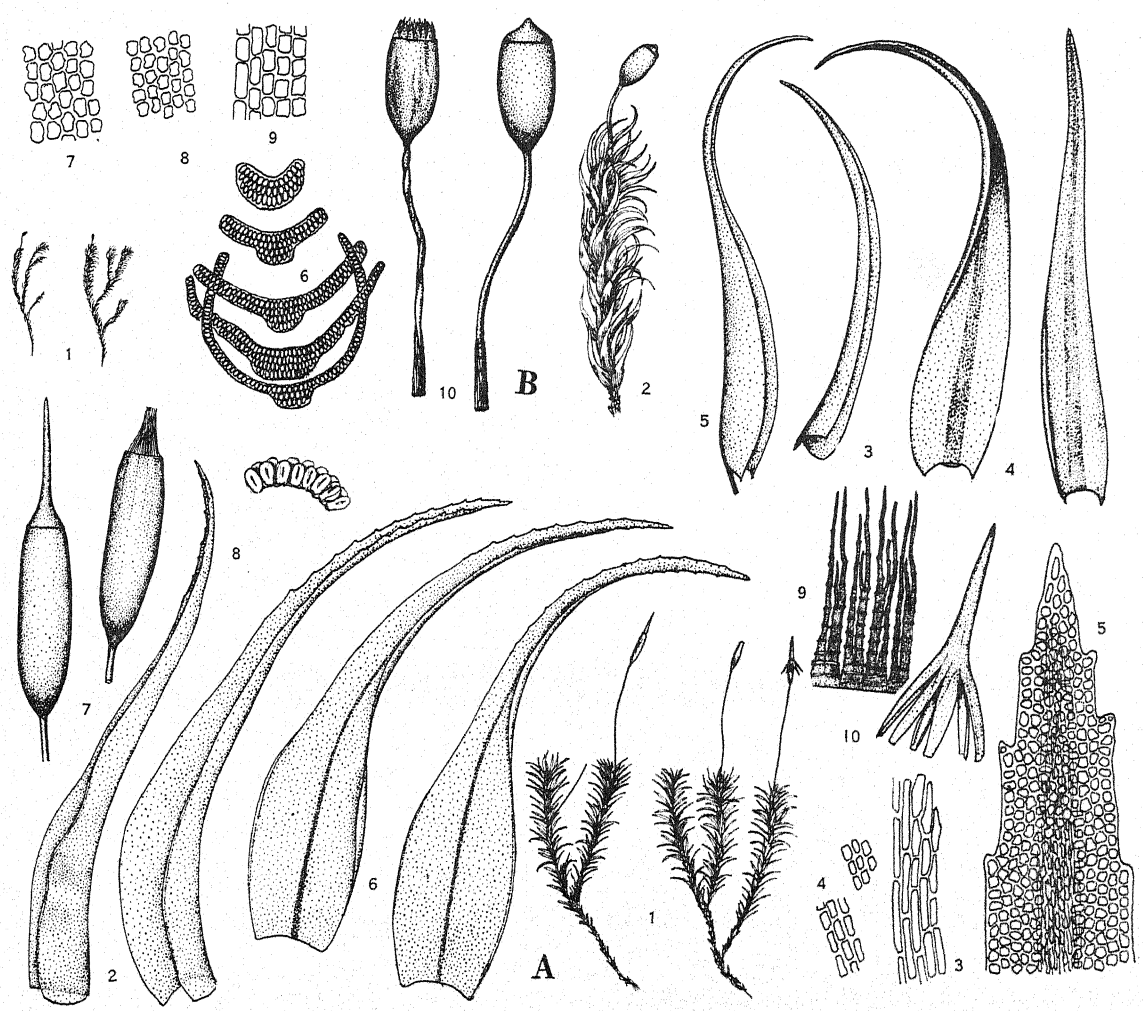
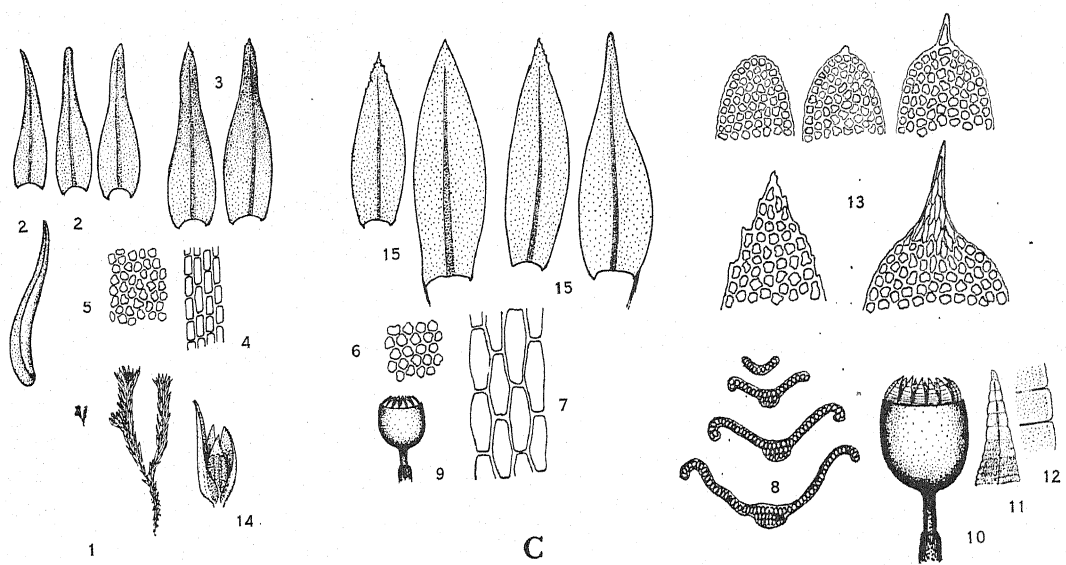


PLATE XXV.

PLATE 25. A. *Ptychomitrium Gardneri*. 1, plants  $\times 1$ ; 2, stem leaves  $\times 20$ ; 3, basal cells  $\times 300$ ; 4, lower and upper median cells  $\times 300$ ; 5, apex of leaf showing cells  $\times 300$ ; 6, perichaetial leaves  $\times 20$ ; 7, capsules  $\times 10$ ; 8, annulus  $\times 300$ ; 9, part of peristome  $\times 30$ ; 10, calyptra  $\times 10$ .

B. *Grimmia hamulosa*. 1, plants  $\times 1$ ; 2, portion of plant  $\times 5$ ; 3, lower leaf  $\times 20$ ; 4, upper leaves  $\times 20$ ; 5, perichaetial leaf  $\times 20$ ; 6, cross sections of leaf  $\times 75$ ; 7, 8, lower and upper median cells  $\times 300$ ; 9, basal cells  $\times 300$ ; 10, capsules  $\times 10$ .

C. *Grimmia coloradensis*. 1, plant  $\times 1$  and  $\times 7.5$ ; 2, lower stem leaves  $\times 20$ ; 3, upper stem leaves  $\times 20$ ; 4, basal leaf cells  $\times 300$ ; 5, median leaf cells  $\times 300$ ; 6, median cells of perichaetial leaf  $\times 300$ ; 7, basal cells of perichaetial leaf  $\times 300$ ; 8, cross sections of leaf  $\times 150$ ; 9, capsule  $\times 10$ ; 10, capsule  $\times 20$ ; 11, peristome tooth  $\times 80$ ; 12, portion of tooth  $\times 300$ ; 13, leaf apices  $\times 300$ ; 14, antheridial bud  $\times 20$ ; 15, perichaetial leaves  $\times 20$ .

(Drawings by Seville Flowers. B & C from the types).